Session 05

VHF+ RF Coverage Modeling with Radio Mobile Software

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Goals

- Consider basic VHF propagation modes and investigate probable RF coverage situations using the Radio Mobile for Windows Radio Propagation and Virtual Mapping Freeware program by VE2DBE.
  - Understand the value of Propagation Modeling Software
  - Understand some of the limitations
  - Make use of it quickly
  - Visual approach to walkthrough of key concepts to setup and operation

Non-Goals

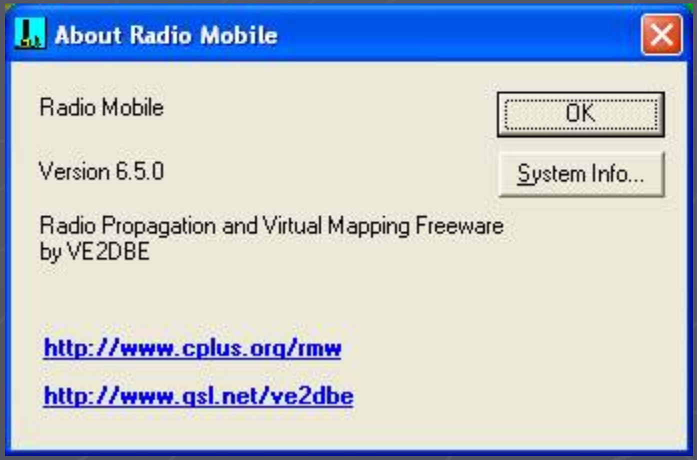
- Make everyone a RF engineer
- Make everyone a Geologist
- Become an expert user
    - If you do be sure to teach the rest of us what you learned!

- Disclaimer
    - I am not an expert user but it lets me compare 2 things with all else being relatively equal
    - Results are reasonably accurate
    - Weak signal modes can be much different

Why Modeling?

- You could personally travel to every good looking location
  - Coordinate a coverage test with a dozen mobile stations? ☹
  - Not convenient - time? no roads?, no equipment yet? ☹
  - Verify only the short list of potential sites ☺
- Perform "What if" calculations on new equipment, different frequencies
  - Calculate power and gain, antenna pattern effects
  - Verify the performance of point-to-point or a network of radio links
- Coordinate station coverage areas
  - Ad-hoc relays
  - Interference potential
  - Repeater site coordination

- RF Propagation Modeling Software
- Terrain Mapping
- Freeware download for personal use
- Authored by VE2DBE
- Automatically downloads maps and data from Internet as required



Radio Mobile

Version 6.5.0

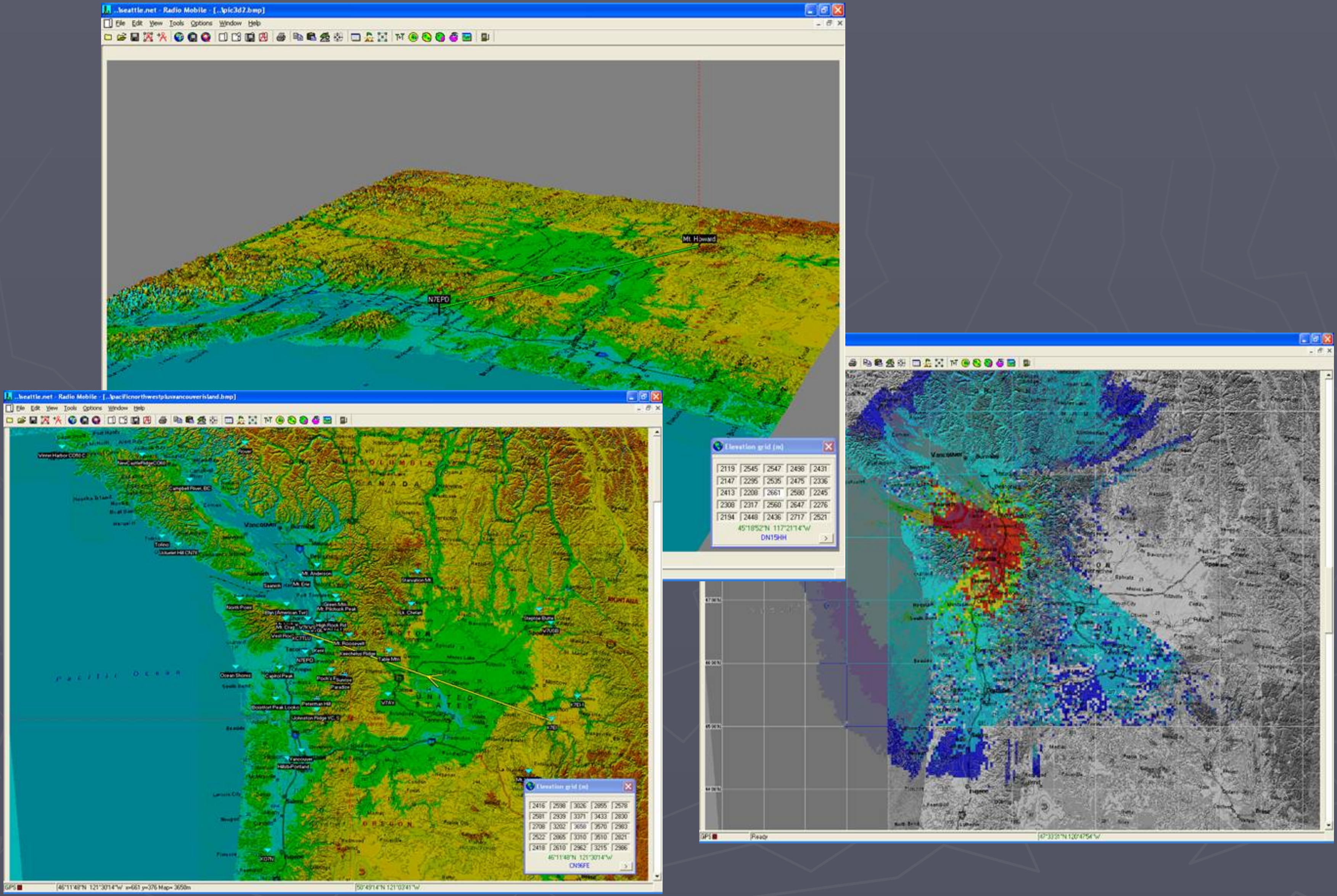
Radio Propagation and Virtual Mapping Freeware
by VE2DBE

http://www.cplus.org/rmw

http://www.qsl.net/ve2dbe

- Several components. The most obvious are
  - Maps
  - Pictures
  - Networks
  - Units
- Each has properties and can be saved in files
- Can be used in various combinations

What is Radio Mobile?


..\seattle.net - Radio Mobile - [..\pic3d2.bmp]
File Edit View Tools Options Window Help
Mt. Howard
N7EPD
..\seattle.net - Radio Mobile - [..\pacificnorthwestplusvancouverisland.bmp]
File Edit View Tools Options Window Help
Pacific Ocean
Vancouver
Ready

Elevation grid (m)

2119	2545	2547	2498	2431
2147	2295	2535	2475	2336
2413	2208	2661	2580	2245
2308	2317	2560	2647	2276
2194	2448	2436	2717	2521

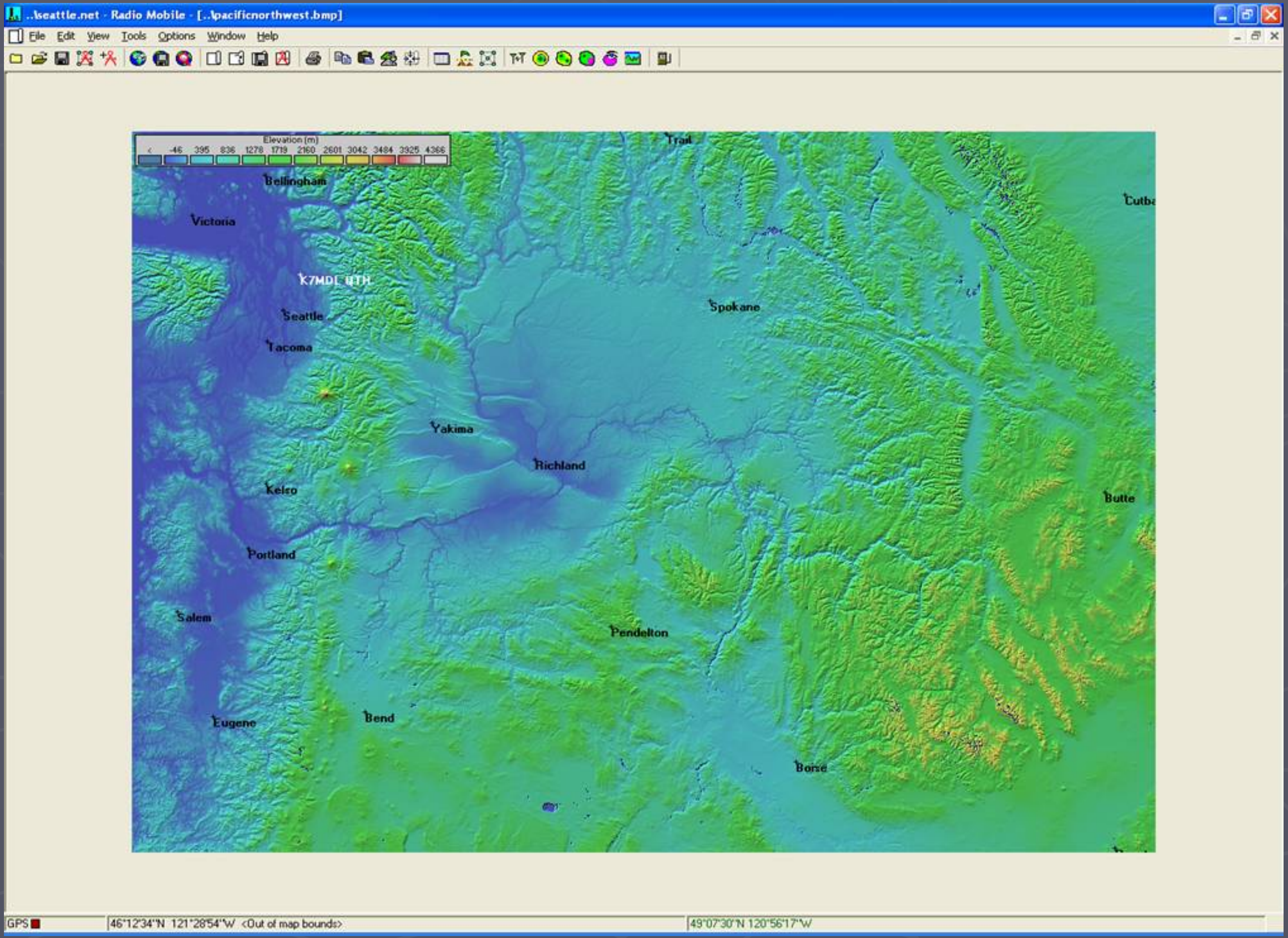
45°18'52"N 117°21'14"W
DN15HH

Elevation grid (m)

2416	2598	3026	2855	2578
2581	2939	3371	3433	2830
2708	3202	3658	3570	2983
2522	2865	3310	3510	2821
2418	2610	2962	3215	2986

46°11'48"N 121°30'14"W
CN96FE

- Basic picture is derived from SRTM data
- Note the land edges are hard to distinguish

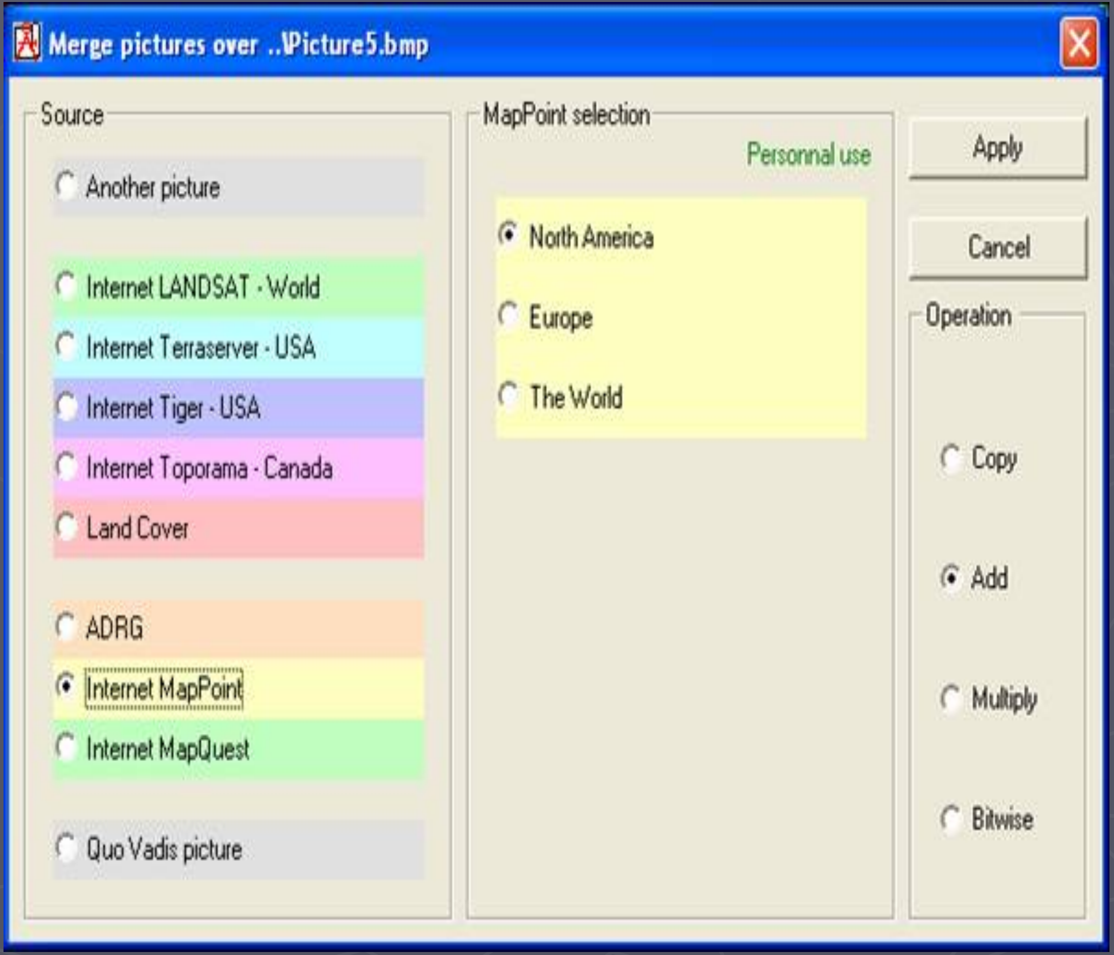


SRTM and DEM

- Shuttle Radar Topography Map (SRTM)
  - Data is available free online
  - Used to provide visible terrain contour views and is a form of DEM
  - Sampled at 3 arcseconds (coarse) or 1 arcsecond (fine detail, large files)
- USGS Digital Terrain Elevation Data (DTED) is free online provides terrain elevation for the US and is available online from the USGS
- SRTM data and DTED data, with your choice of road map overlays enable the accurate spotting of radio locations and the analysis of path loss between them

Picture Overlays (Edit: Merge)

- Merge road or topographic maps from internet sources.
- Can be other pictures
- Add, Bitwise, Copy, Multiply
  - Affect readability & color depth



Merge pictures over ..\Picture5.bmp

Source
- ○ Another picture
- ○ Internet LANDSAT - World
- ○ Internet Terraserver - USA
- ○ Internet Tiger - USA
- ○ Internet Toporama - Canada
- ○ Land Cover
- ○ ADRG
- ● Internet MapPoint
- ○ Internet MapQuest
- ○ Quo Vadis picture

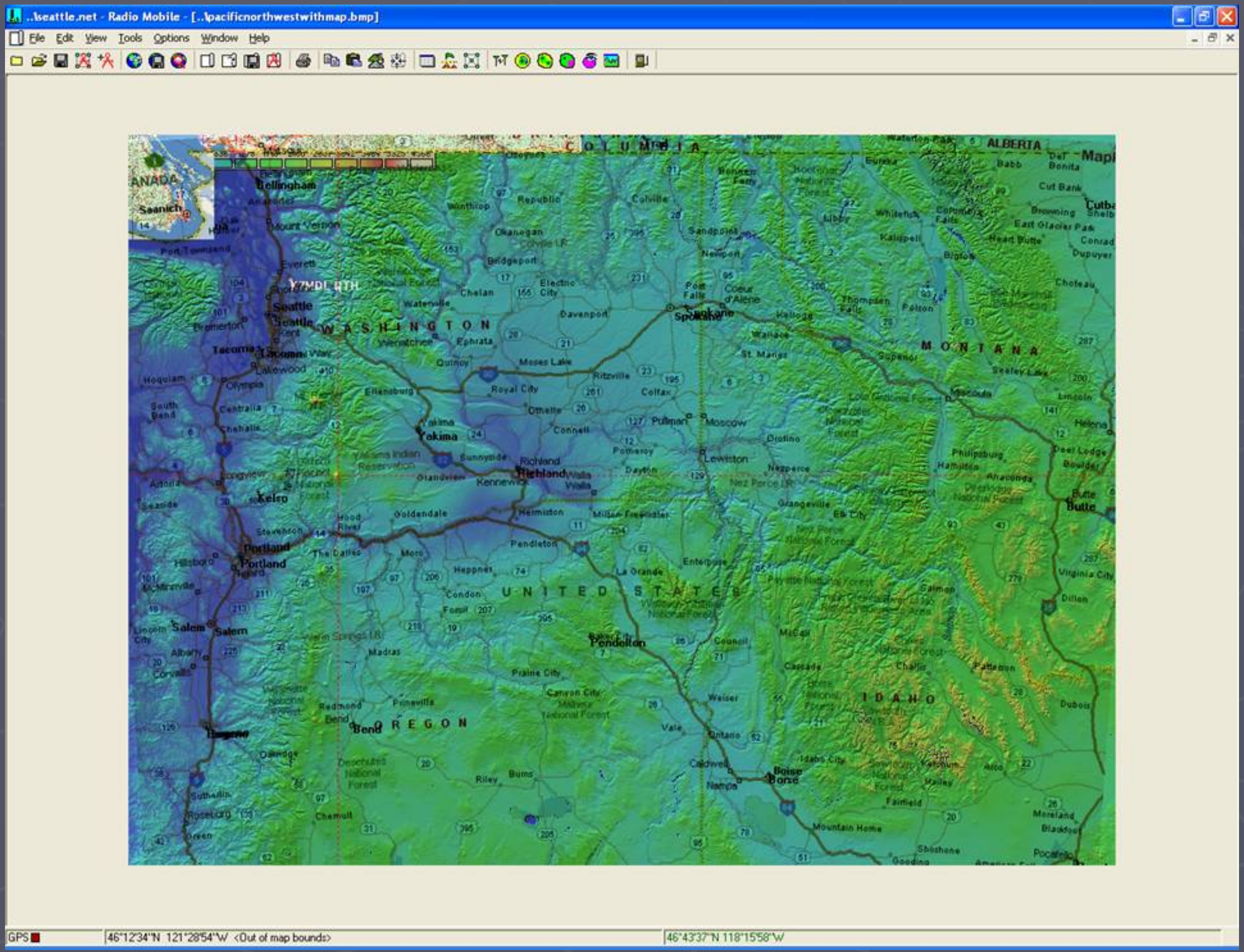
MapPoint selection

Personnal use
- ● North America
- ○ Europe
- ○ The World

Operation
- ○ Copy
- ● Add
- ○ Multiply
- ○ Bitwise

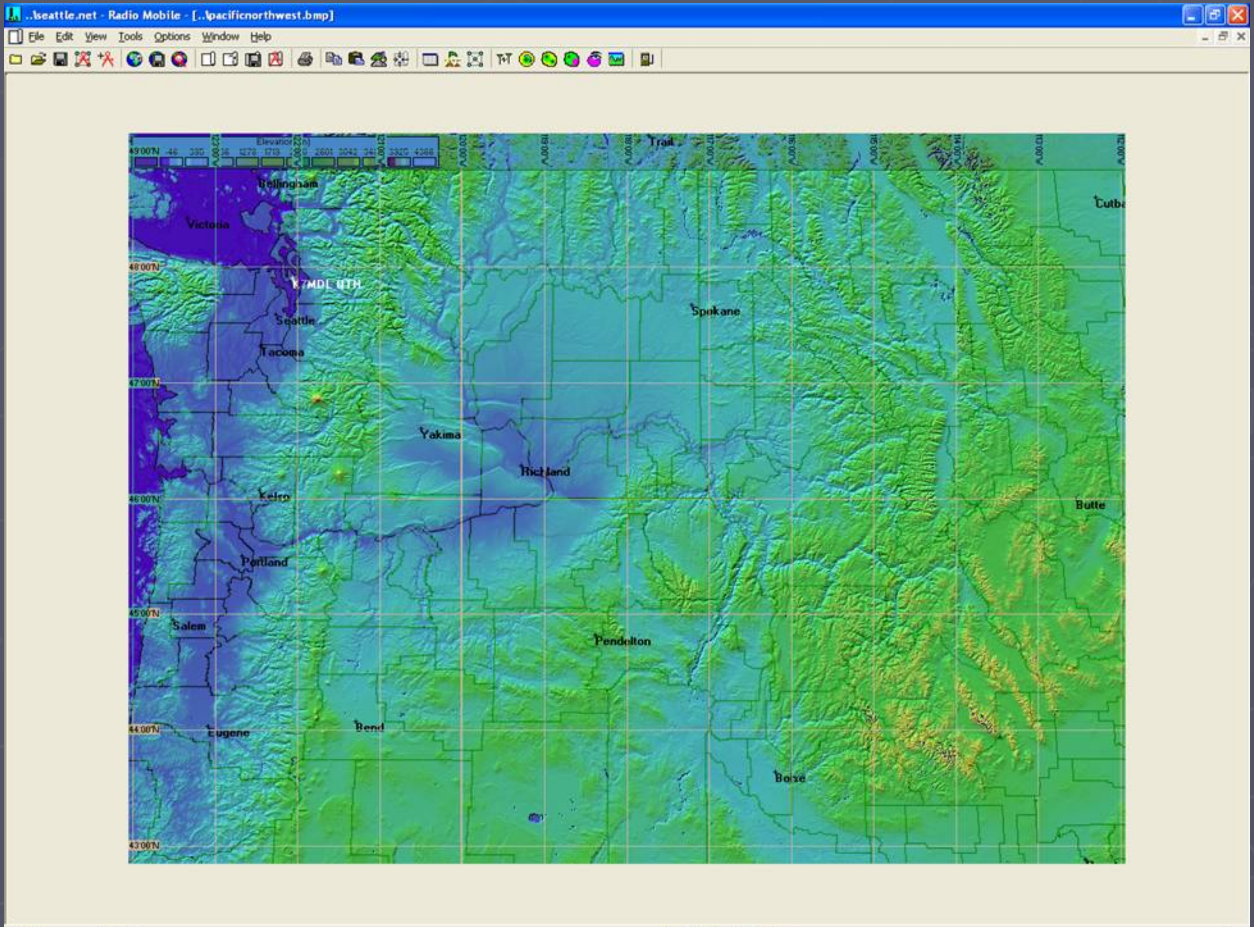
Picture With Map Overlay

- Basic picture with road map added
- Note major state roads
- Using Bitwise makes a bit lighter


..\seattle.net - Radio Mobile - [..\pacificnorthwestwithmap.bmp]
File
Edit
View
Tools
Options
Window
Help
GPS
46°12'34"N 121°28'54"W <Out of map bounds>
46°43'37"N 118°15'58"W

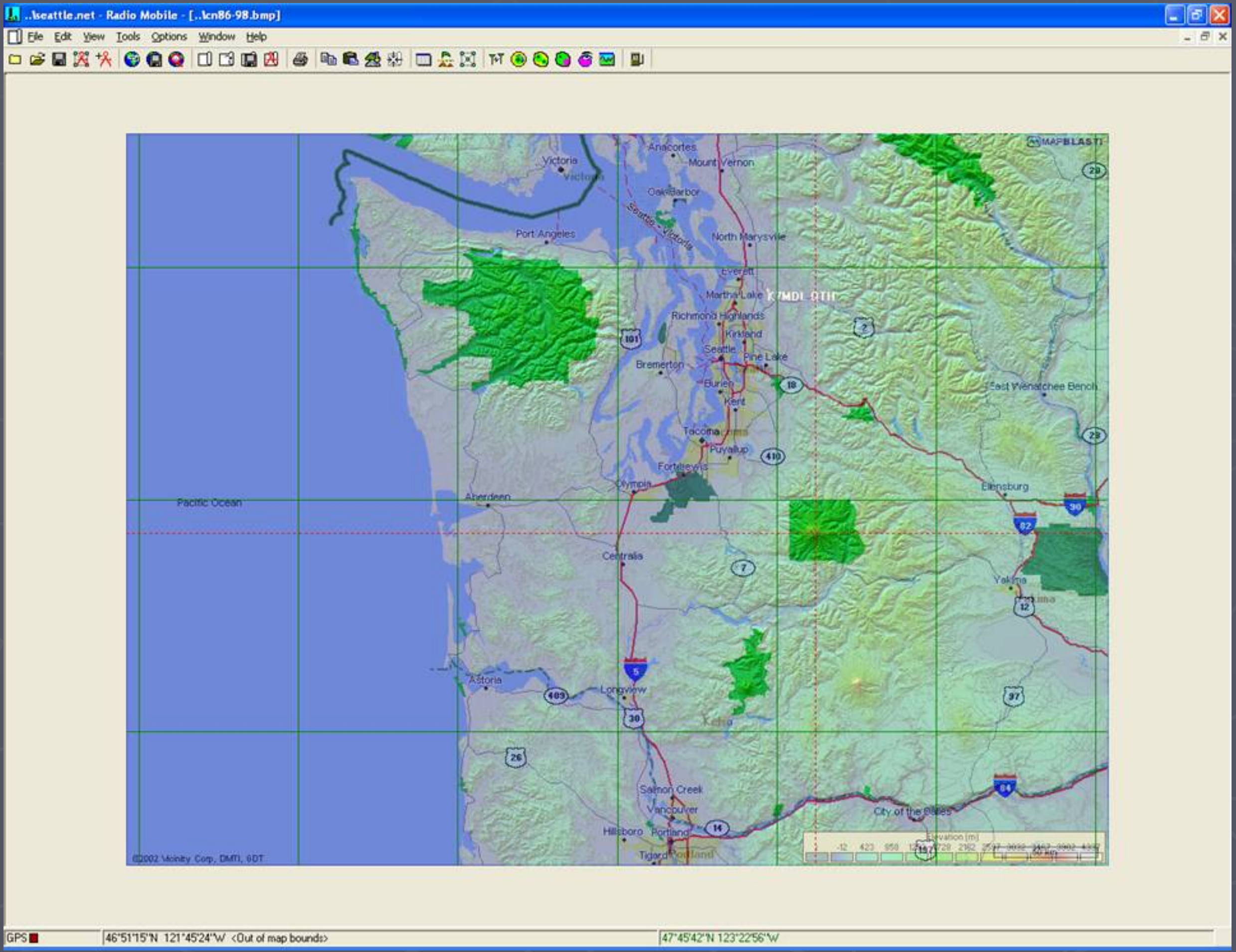
Overlays: Grids Lines & Counties

- Same SRTM picture
- Lat long grid lines
- County and Land outlines



Overlays: Relief & Major Roads

- Another map type example
- Land outline
- Interstates only shown to reduce clutter
- National Parks in green
- Added in Lat/Long grid

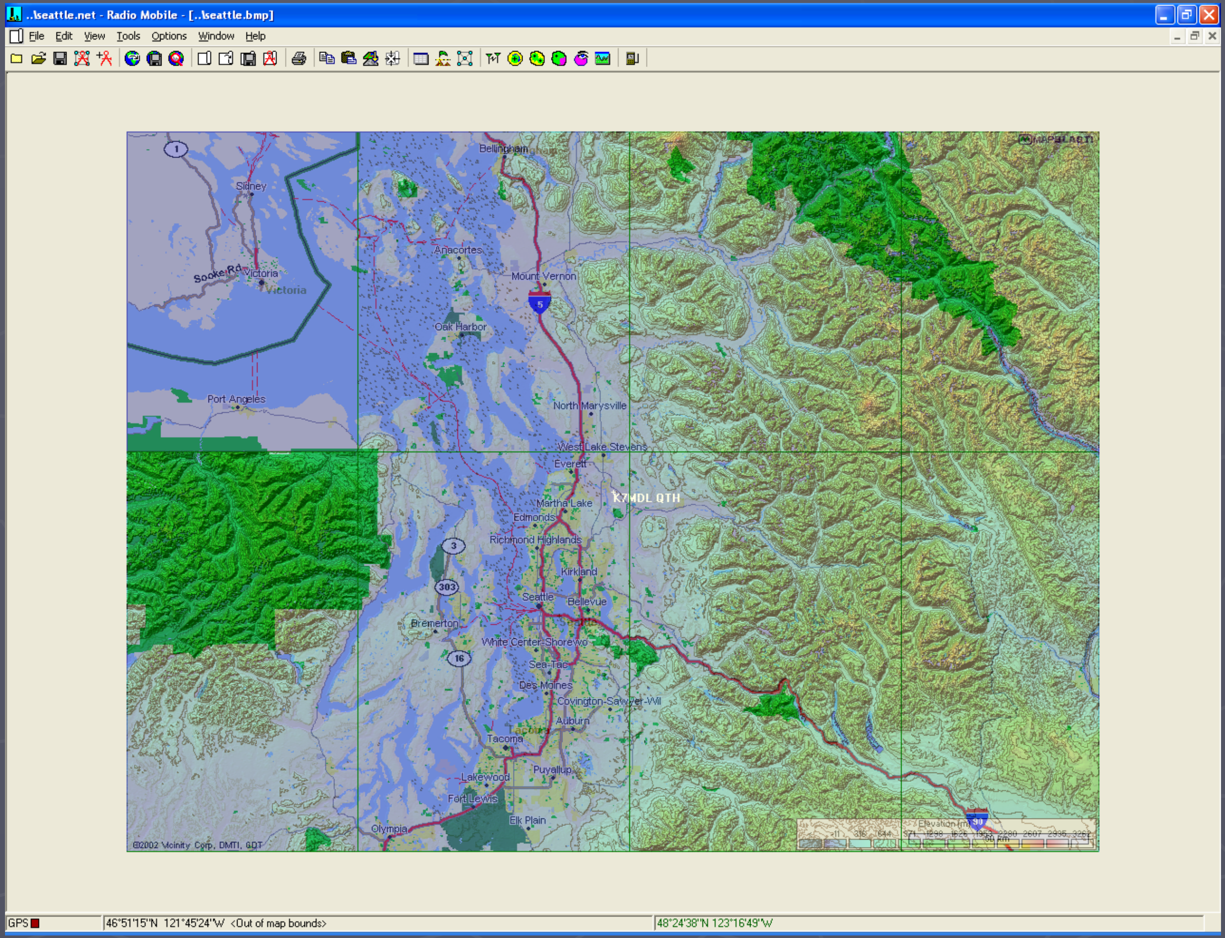


GPS ■ 46°51'15"N 121°45'24"W <Out of map bounds>

47°45'42"N 123°22'56"W

Overlays: Topographic Contours

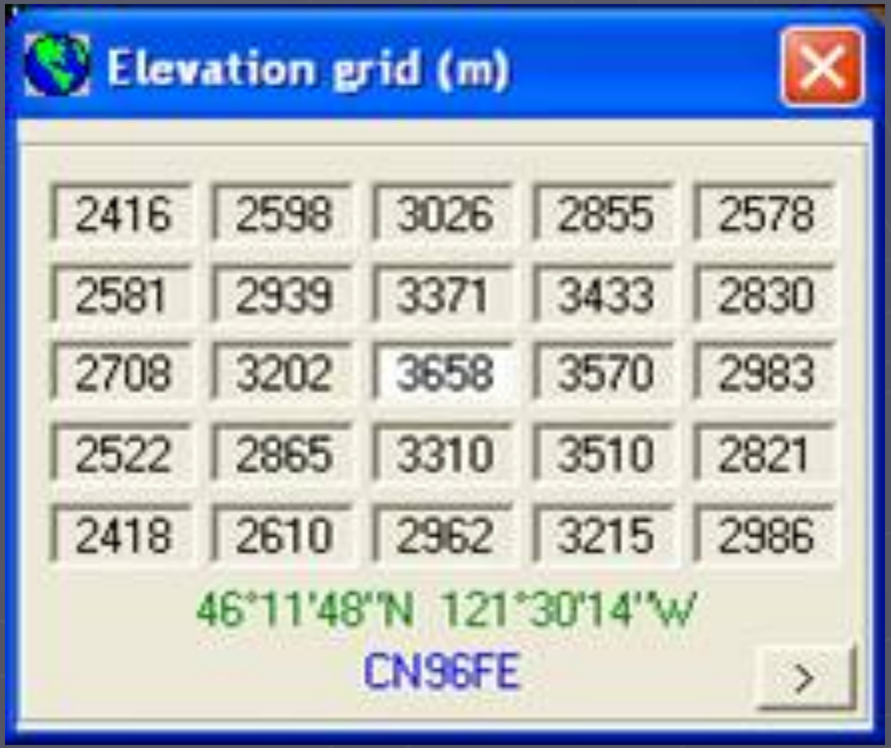
- Same picture as before
- Different scale
- Contour lines shown every 300 meters
- Brings out high spots



GPS 46°51'15"N 121°45'24"W <Out of map bounds> 48°24'38"N 123°16'49"W

Elevation Grid

- Elevation Grid uses DEM data, shows elevation at cursor and surrounding points
- Can automatically locate highest peak in map
- Displays Lat, Long, and 6 Digit Grid location



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46°11'48"N 121°30'14"W

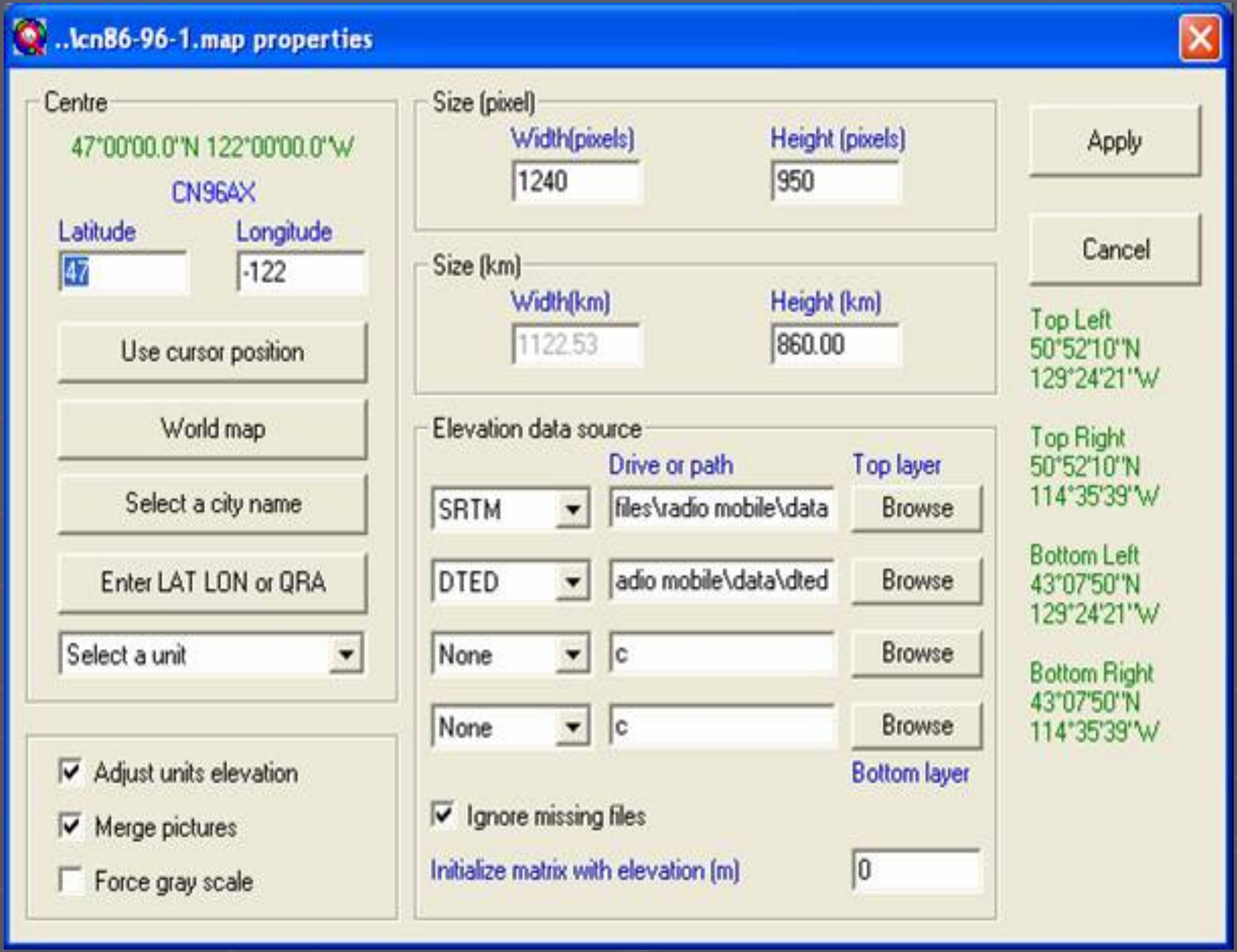
CN96FE

How to setup up Radio Mobile

- Open a Map
  - Center location using Latitude and Longitude (I use 47 and -122)
  - Set Picture Size (I use 1240x950)
  - Set data directory locations (SRTM and DTED) - Have lots of disk space!
  - Can create several maps and save to files
  - Pictures are separate objects – can select combinations
- Open a Picture
  - Map properties determine picture boundaries
  - Can merge several pictures or picture types
  - Can save different views to files
  - Data files will automatically download for missing areas
- Create Units
  - Place unit at various location – use Lat-Long, grid square, city names
- Open a Network
  - Create Systems, assign properties and relationships among Units
  - Not directly related to pictures, but must align to be visible
  - Save networks with Units to files

Maps

- 47N and -122W is my map center
- Set directories to store data files
- Set picture size to fit screen resolution (1240x950)
  - Affects displayed map distance



..\cn86-96-1.map properties

Centre

47°00'00.0"N 122°00'00.0"W

CN96AX

Latitude: 47

Longitude: -122

☑ Adjust units elevation

☑ Merge pictures

☐ Force gray scale

Size (pixel)

Width(pixels): 1240

Height (pixels): 950

Size (km)

Width(km): 1122.53

Height (km): 860.00

Elevation data source

	Drive or path	Top layer
SRTM	files\radio mobile\data	Browse
DTED	adio mobile\data\dted	Browse
None	c	Browse
None	c	Browse
		Bottom layer

☑ Ignore missing files

Initialize matrix with elevation (m): 0

Top Left
50°52'10"N
129°24'21"W

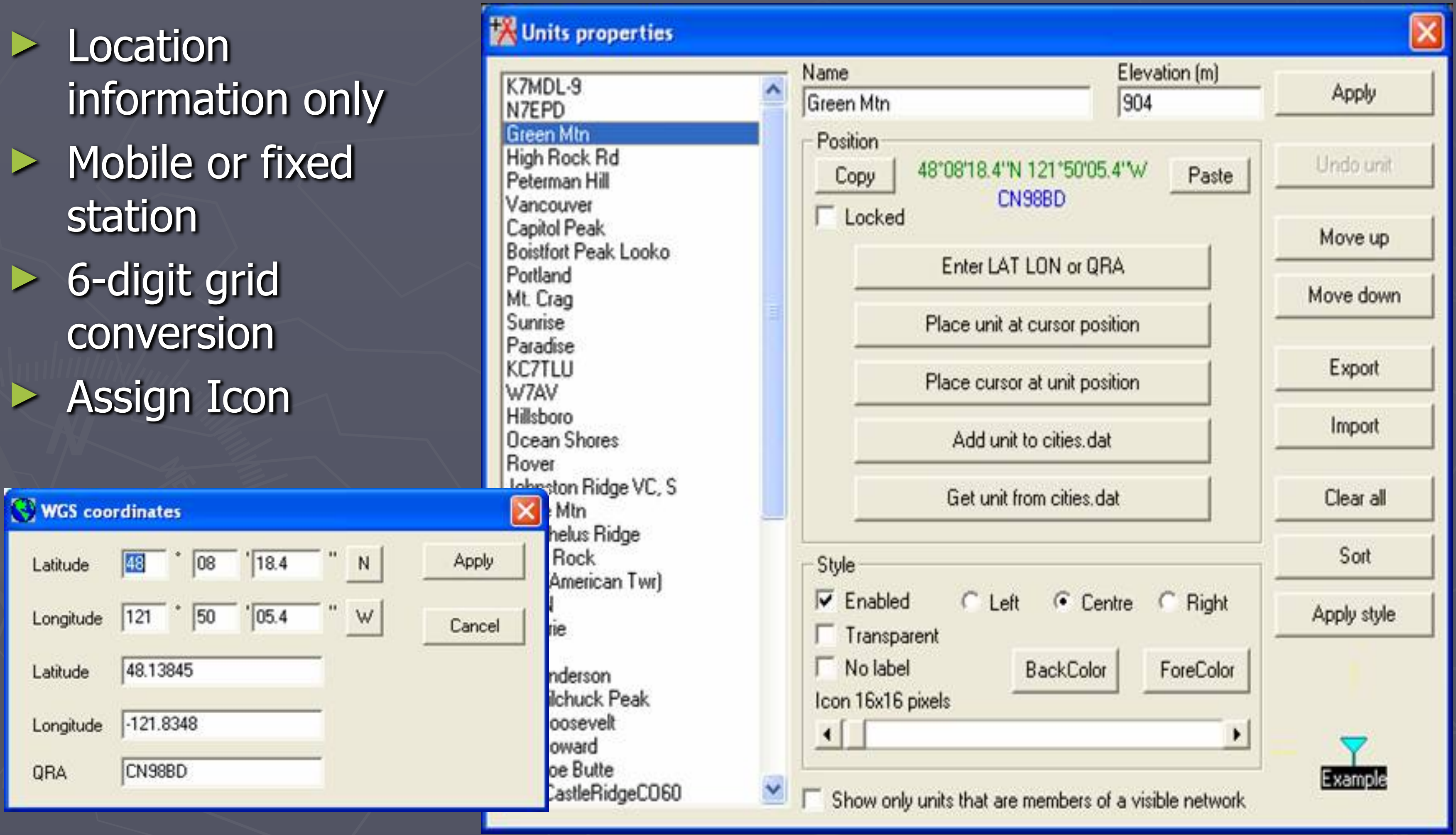
Top Right
50°52'10"N
114°35'39"W

Bottom Left
43°07'50"N
129°24'21"W

Bottom Right
43°07'50"N
114°35'39"W

Units

- Location information only
- Mobile or fixed station
- 6-digit grid conversion
- Assign Icon



Units properties

K7MDL-9
N7EPD
Green Mtn
High Rock Rd
Peterman Hill
Vancouver
Capitol Peak
Boistfort Peak Looko
Portland
Mt. Crag
Sunrise
Paradise
KC7TLU
W7AV
Hillsboro
Ocean Shores
Rover
Johnston Ridge VC, S
e Mtn
helus Ridge
Rock
American Twr)
l
rie

nderson
lchuck Peak
oosevelt
oward
oe Butte
CastleRidgeCO60

Name	Green Mtn
Elevation (m)	904

Position

48°08'18.4"N 121°50'05.4"W
CN98BD

☐ Locked

Style

☑ Enabled ○ Left ● Centre ○ Right
☐ Transparent
☐ No label
Icon 16x16 pixels

☐ Show only units that are members of a visible network

WGS coordinates

Latitude	48 °	08 '	18.4 "	N
Longitude	121 °	50 '	05.4 "	W
Latitude	48.13845			
Longitude	-121.8348			
QRA	CN98BD			

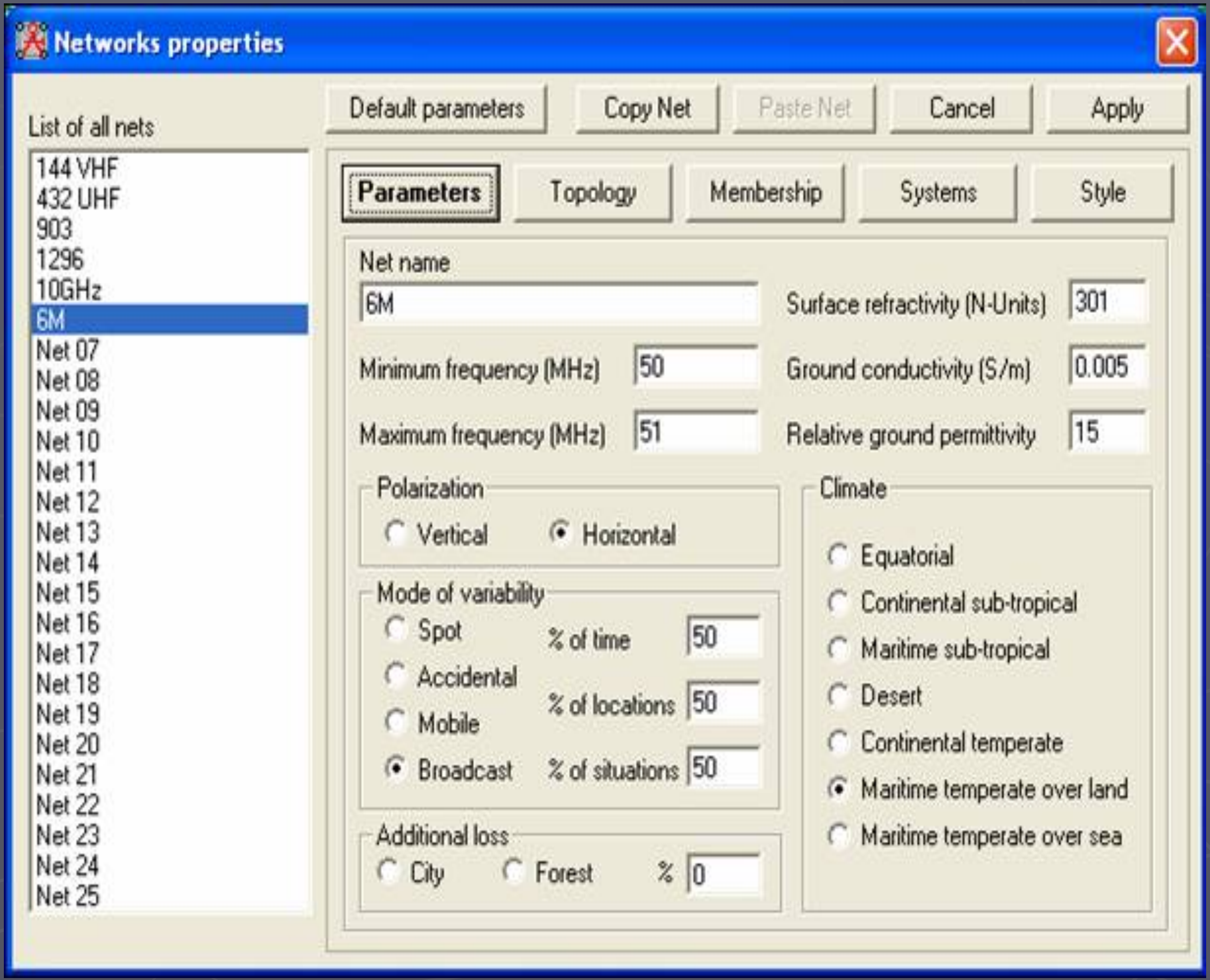
Networks

- Networks of links between Units can be configured with control of the power, height, and gain, and environment conditions. This is useful for repeater location planning and frequency coordination as well as planning ad-hoc mobile simplex net control operating locations.

- Parameters
  - Setup environmental conditions
  - Limitations and assumptions
- Topology
  - Voice or Data, clustered or star
- Systems
  - Set general characteristic of a group of Units
  - Antenna gain, power, line loss, tower/mast height above ground
- Membership
  - Associate Units with Systems for each Network (Net)
- Style
  - Green, Yellow, Red Lines
  - Shows relative signal strength

Parameters

- Can create many combinations – give descriptive names
- Choose best Climate match
- Set Frequency & antenna polarization
- Use defaults for other parameters unless you know different!



List of all nets
144 VHF
432 UHF
903
1296
10GHz
6M
Net 07
Net 08
Net 09
Net 10
Net 11
Net 12
Net 13
Net 14
Net 15
Net 16
Net 17
Net 18
Net 19
Net 20
Net 21
Net 22
Net 23
Net 24
Net 25

Net name: 6M
Minimum frequency (MHz): 50
Maximum frequency (MHz): 51
Surface refractivity (N-Units): 301
Ground conductivity (S/m): 0.005
Relative ground permittivity: 15

Polarization
○ Vertical ● Horizontal

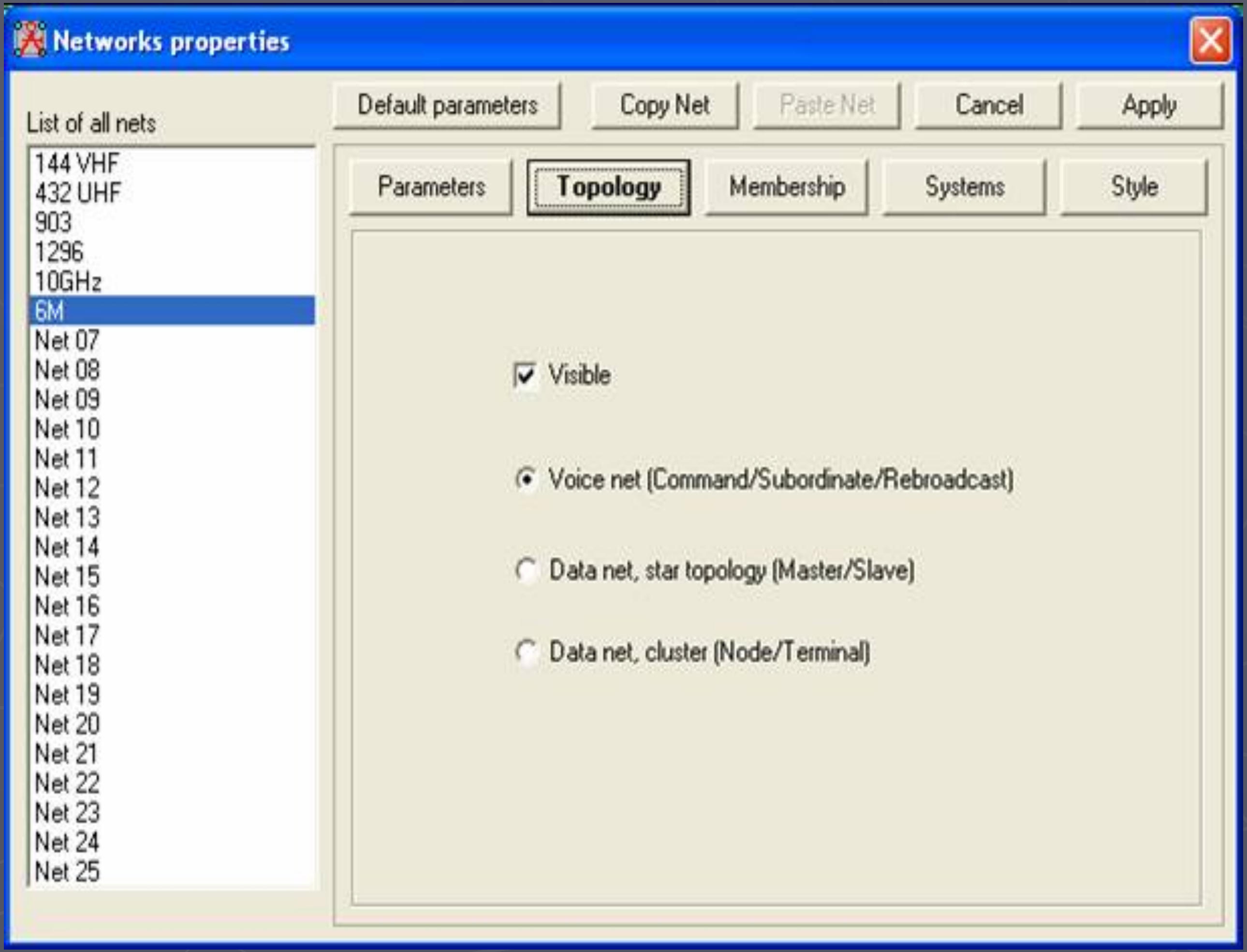
Mode of variability
○ Spot
○ Accidental
○ Mobile
● Broadcast
% of time: 50
% of locations: 50
% of situations: 50

Additional loss
○ City ○ Forest %: 0

Climate
○ Equatorial
○ Continental sub-tropical
○ Maritime sub-tropical
○ Desert
○ Continental temperate
● Maritime temperate over land
○ Maritime temperate over sea

Topology

- Normally choose Voice net
- Set for each net



☑ Visible

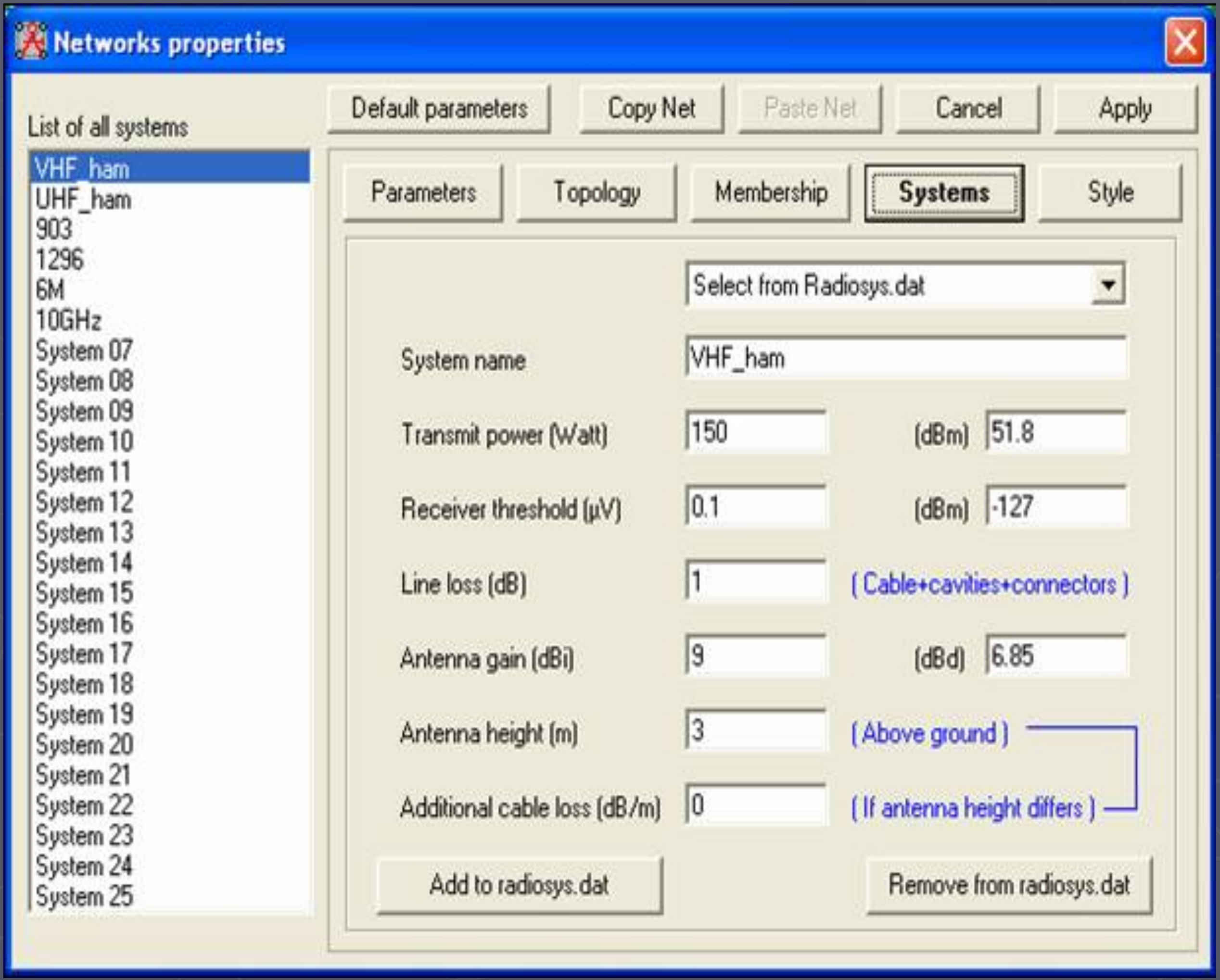
● Voice net (Command/Subordinate/Rebroadcast)

○ Data net, star topology (Master/Slave)

○ Data net, cluster (Node/Terminal)

Systems

- Set power & gain, loss, etc.
- Choose system
- I keep frequencies separate, but repeater systems may use many bands



List of all systems

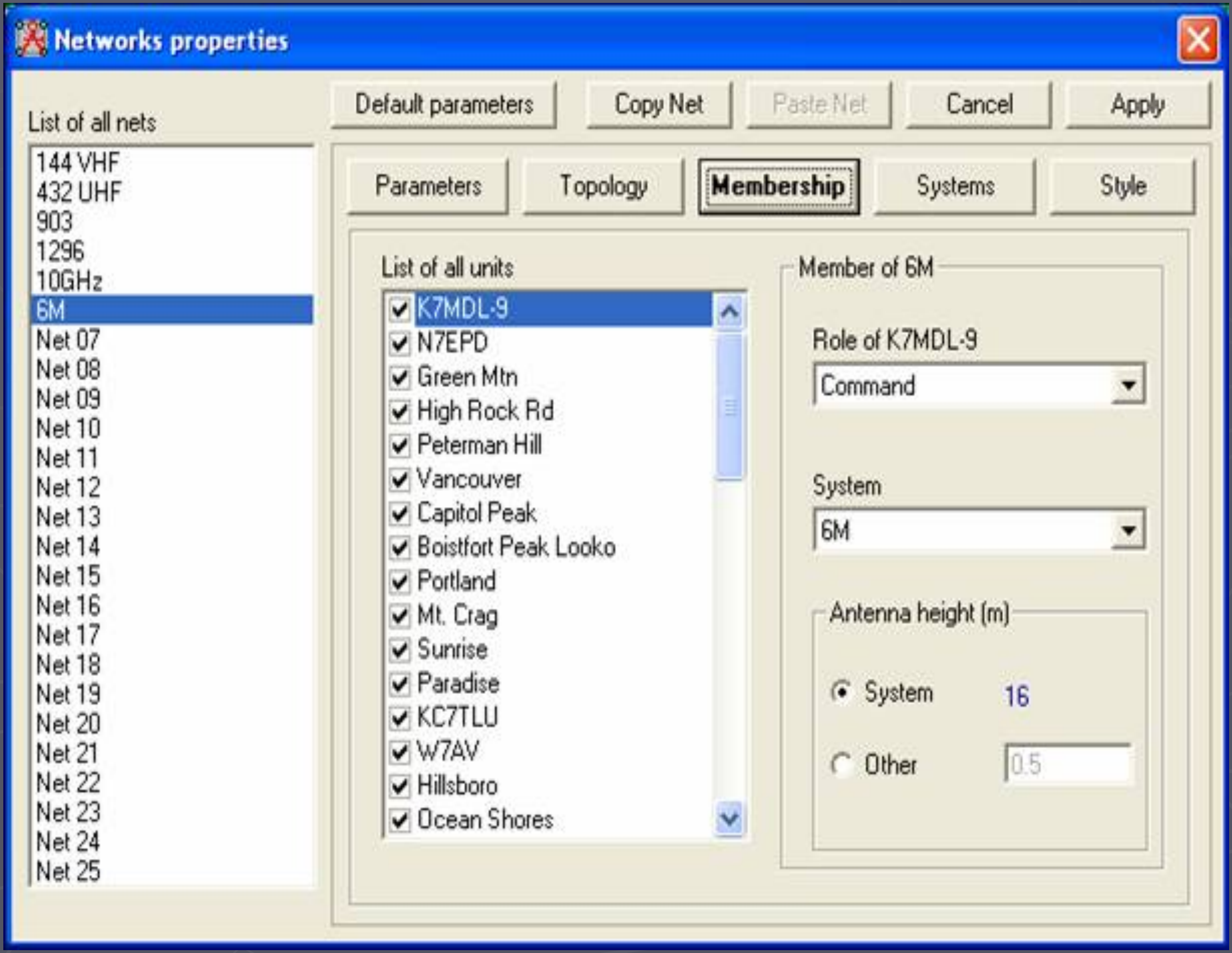
VHF_ham
UHF_ham
903
1296
6M
10GHz
System 07
System 08
System 09
System 10
System 11
System 12
System 13
System 14
System 15
System 16
System 17
System 18
System 19
System 20
System 21
System 22
System 23
System 24
System 25

Select from Radiosys.dat

System name: VHF_ham
Transmit power (Watt): 150 (dBm) 51.8
Receiver threshold (µV): 0.1 (dBm) -127
Line loss (dB): 1 (Cable+cavities+connectors)
Antenna gain (dBi): 9 (dBd) 6.85
Antenna height (m): 3 (Above ground)
Additional cable loss (dB/m): 0 (If antenna height differs)

Membership

- Associate Units with a Net and System
- Can override each Unit antenna height



List of all nets

- 144 VHF
- 432 UHF
- 903
- 1296
- 10GHz
- 6M
- Net 07
- Net 08
- Net 09
- Net 10
- Net 11
- Net 12
- Net 13
- Net 14
- Net 15
- Net 16
- Net 17
- Net 18
- Net 19
- Net 20
- Net 21
- Net 22
- Net 23
- Net 24
- Net 25

List of all units

- ☑ K7MDL-9
- ☑ N7EPD
- ☑ Green Mtn
- ☑ High Rock Rd
- ☑ Peterman Hill
- ☑ Vancouver
- ☑ Capitol Peak
- ☑ Boistfort Peak Looko
- ☑ Portland
- ☑ Mt. Crag
- ☑ Sunrise
- ☑ Paradise
- ☑ KC7TLU
- ☑ W7AV
- ☑ Hillsboro
- ☑ Ocean Shores

Member of 6M

Role of K7MDL-9

Command

System

6M

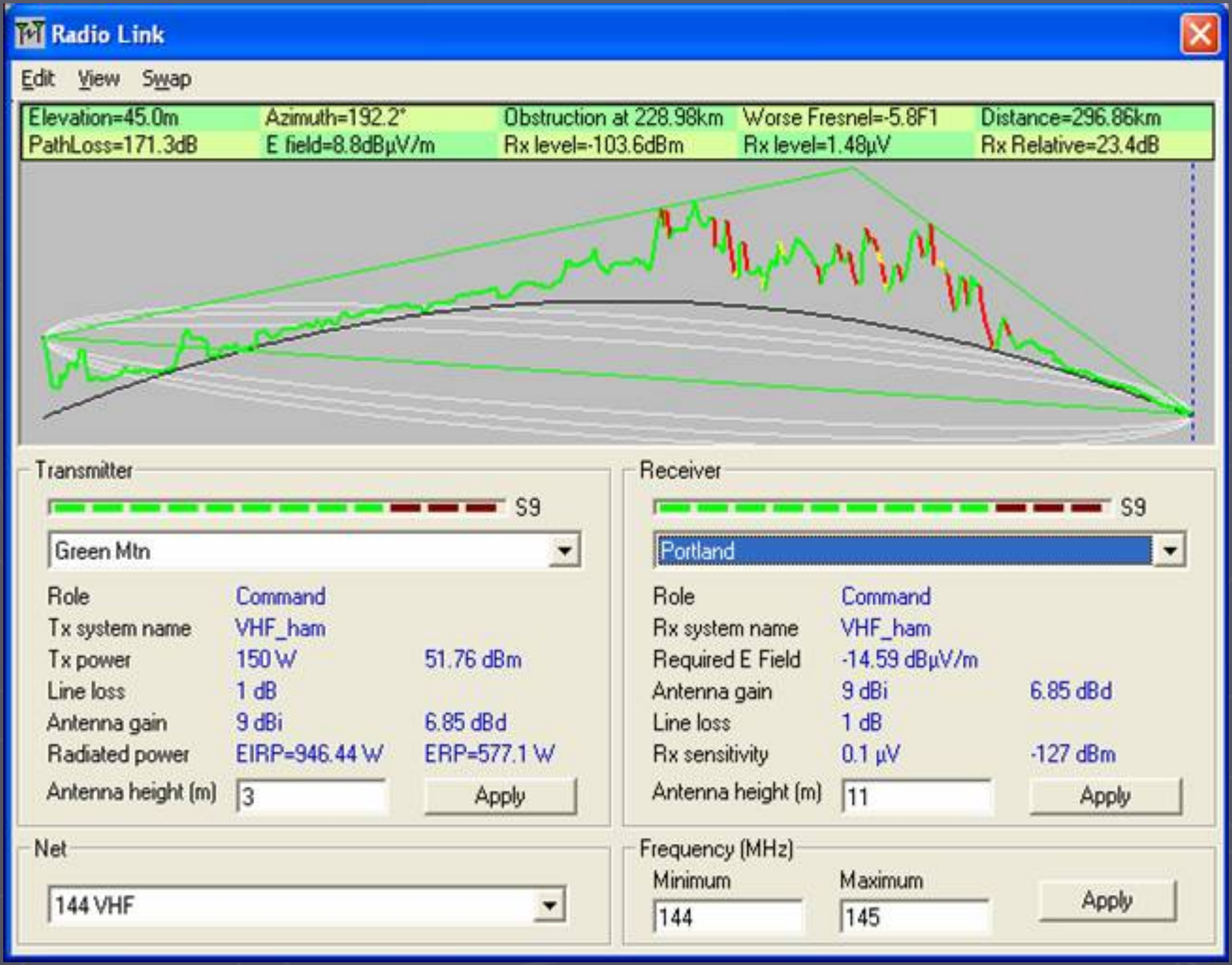
Antenna height (m)

● System 16

○ Other 0.5

Point to Point (Radio Link)

- Terrain profile
- Data window
- Choose 2 units
- Select Network



Elevation=45.0m
Azimuth=192.2°
Obstruction at 228.98km
Worse Fresnel=-5.8F1
Distance=296.86km
PathLoss=171.3dB
E field=8.8dBµV/m
Rx level=-103.6dBm
Rx level=1.48µV
Rx Relative=23.4dB

Transmitter

Green Mtn

Role	Command	
Tx system name	VHF_ham	
Tx power	150 W	51.76 dBm
Line loss	1 dB	
Antenna gain	9 dBi	6.85 dBd
Radiated power	EIRP=946.44 W	ERP=577.1 W
Antenna height (m)	3	

Receiver

Portland

Role	Command	
Rx system name	VHF_ham	
Required E Field	-14.59 dBµV/m	
Antenna gain	9 dBi	6.85 dBd
Line loss	1 dB	
Rx sensitivity	0.1 µV	-127 dBm
Antenna height (m)	11	

Net

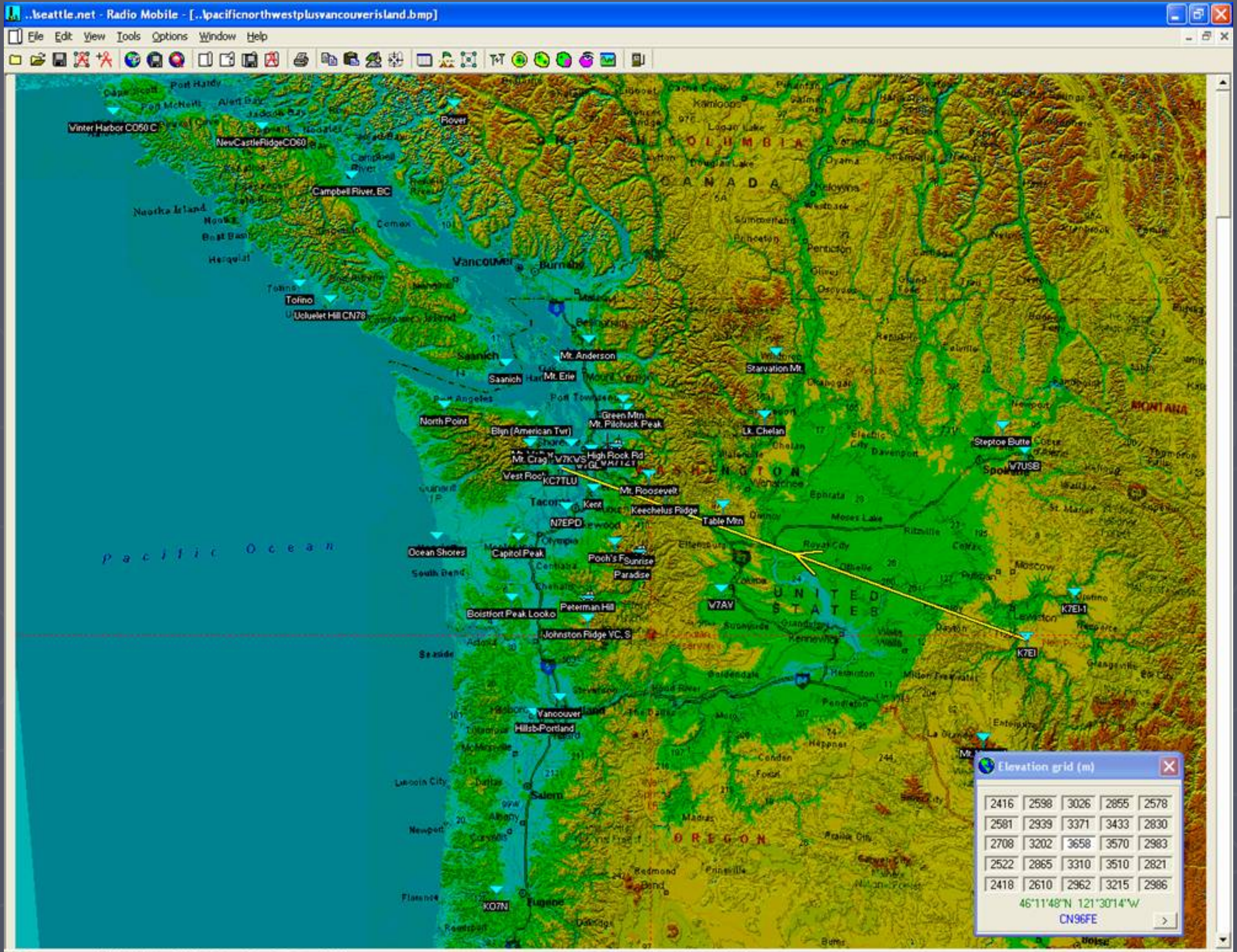
144 VHF

Frequency (MHz)

Minimum: 144
Maximum: 145

Network Map

- Terrain profile
- Data window
- Choose 2 units
- Select Network



..\seattle.net - Radio Mobile - [..\pacificnorthwestplusvancouverisland.bmp]

2416	2598	3026	2855	2578
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46°11'48"N 121°30'14"W

CN96FE

GPS

46°11'48"N 121°30'14"W x=661 y=376 Map= 3658m

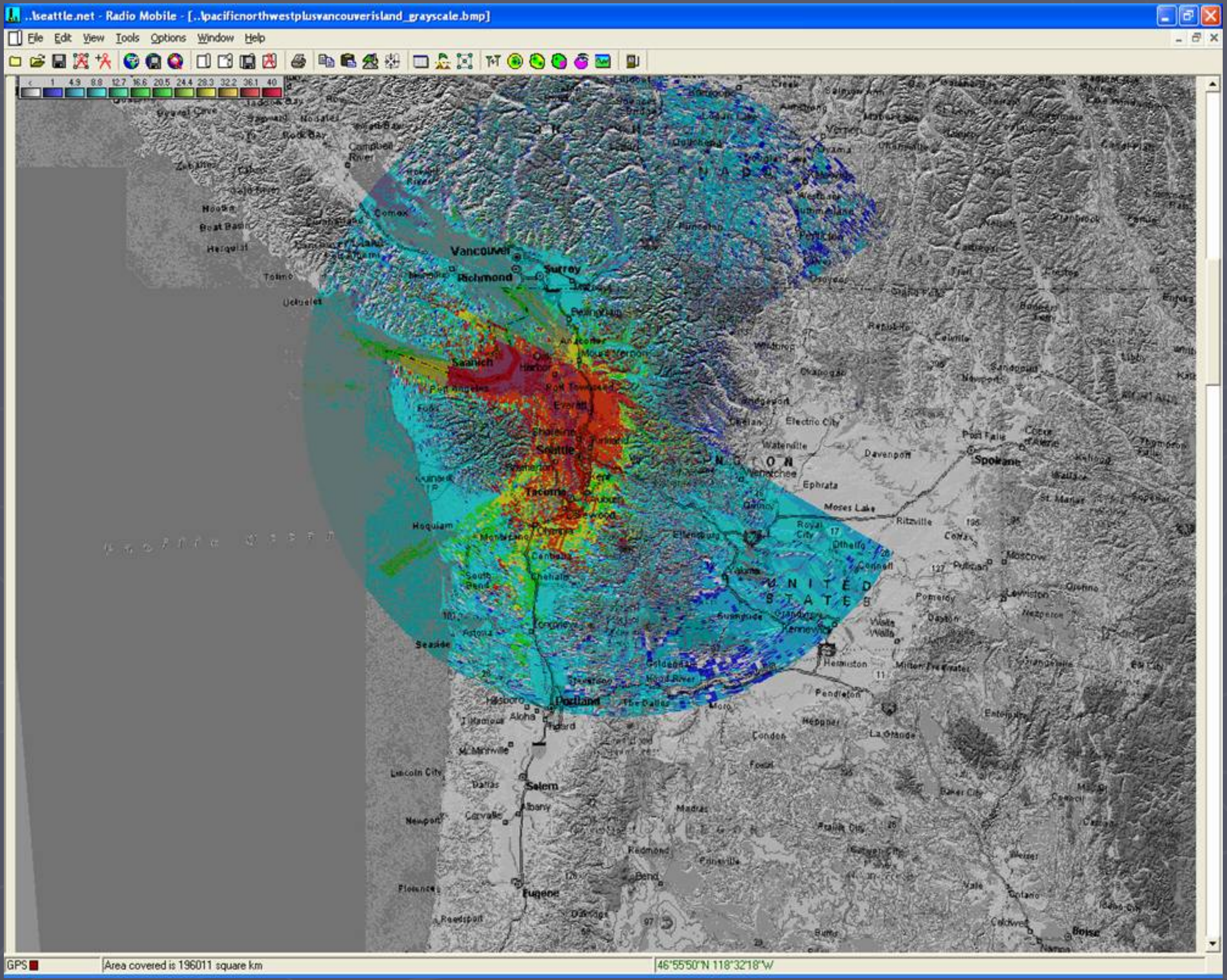
50°49'14"N 121°03'41"W

Tools

- Radio Coverage
  - Single Polar
  - Combined Cartesian
  - Interference
- Visual Coverage
- Visual Horizon
- Radio Link
- HAAT

Tools: Radio Coverage Single Polar

- 300km radius used centered on Green Mtn. CN98
- Rainbow fill on gray scale picture for best visibility
- Note intensity levels, blockage eastward, terrain shadows



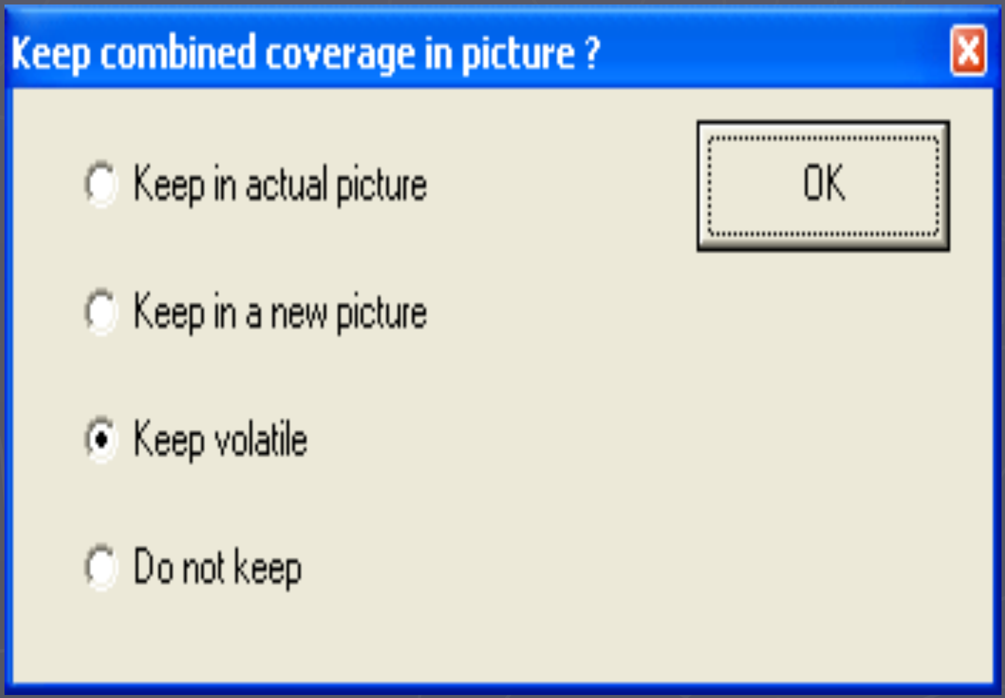
..\seattle.net - Radio Mobile - [..\pacificnorthwestplusvancouverisland_grayscale.bmp]

Area covered is 196011 square km

46°55'50"N 118°32'18"W

☺ Working Tip

- Pressing escape or recomputing coverage areas will undo change to picture and redraw fresh information
- Use “Keep Volatile‟ most of the time
- “Keep in new picture” overlays multiple computations. Good for saving maps on pictures.
- Grey scale picture is best (View: Force Grey Scale, Keep in New picture)



Keep combined coverage in picture ?

○ Keep in actual picture

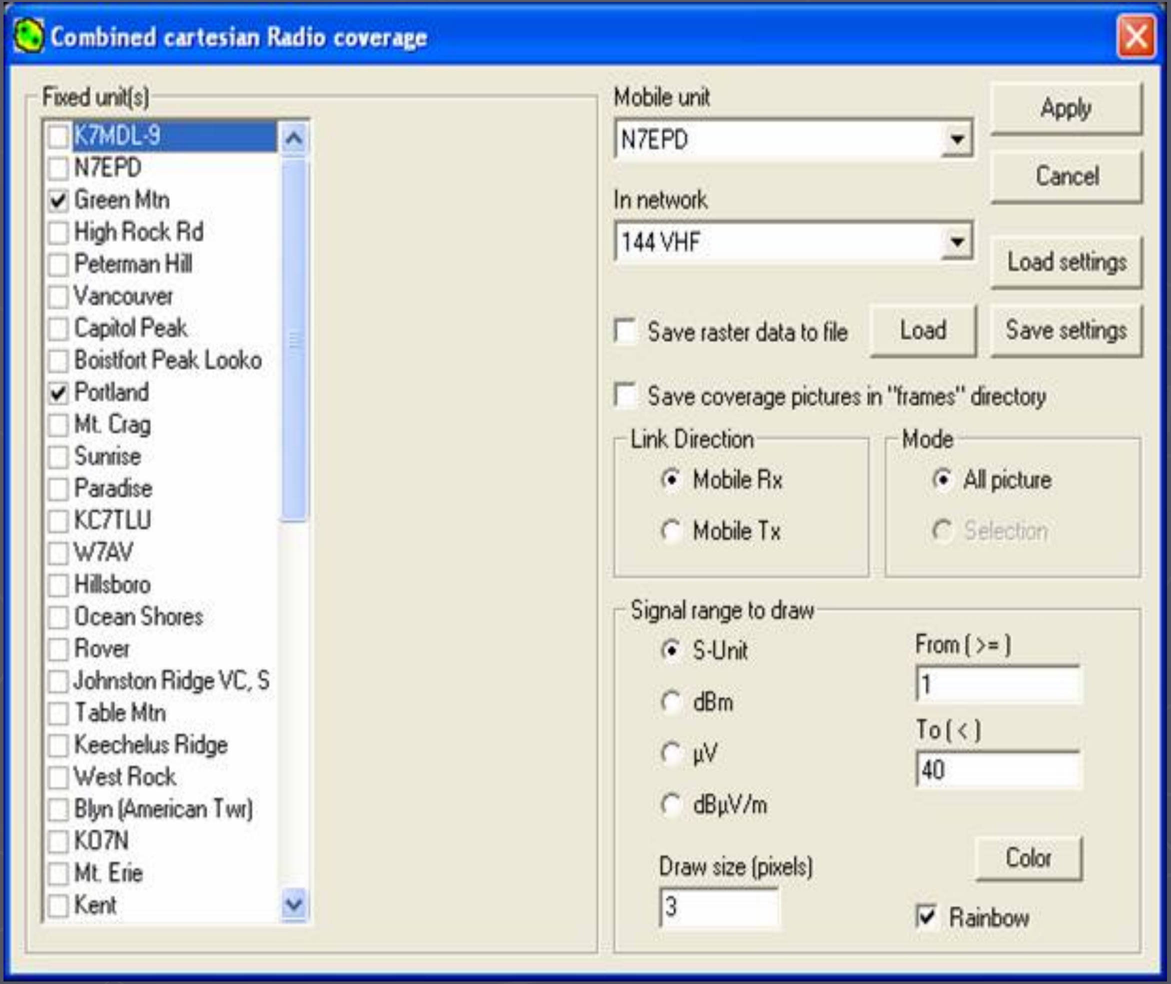
○ Keep in a new picture

● Keep volatile

○ Do not keep

Tools: Radio Coverage Combined Cartesian

- Useful to see what total area of coverage might be for simplex co-operating relay stations
- Rainbow selection show relative signal intensity over region



Combined cartesian Radio coverage

Fixed unit(s)

☐ K7MDL-9
☐ N7EPD
☑ Green Mtn
☐ High Rock Rd
☐ Peterman Hill
☐ Vancouver
☐ Capitol Peak
☐ Boistfort Peak Looko
☑ Portland
☐ Mt. Crag
☐ Sunrise
☐ Paradise
☐ KC7TLU
☐ W7AV
☐ Hillsboro
☐ Ocean Shores
☐ Rover
☐ Johnston Ridge VC, S
☐ Table Mtn
☐ Keechelus Ridge
☐ West Rock
☐ Blyn (American Twr)
☐ KO7N
☐ Mt. Erie
☐ Kent

Mobile unit: N7EPD

In network: 144 VHF

☐ Save raster data to file

☐ Save coverage pictures in "frames" directory

Link Direction: ● Mobile Rx ○ Mobile Tx

Mode: ● All picture ○ Selection

Signal range to draw: ● S-Unit ○ dBm ○ µV ○ dBµV/m

From (>=): 1

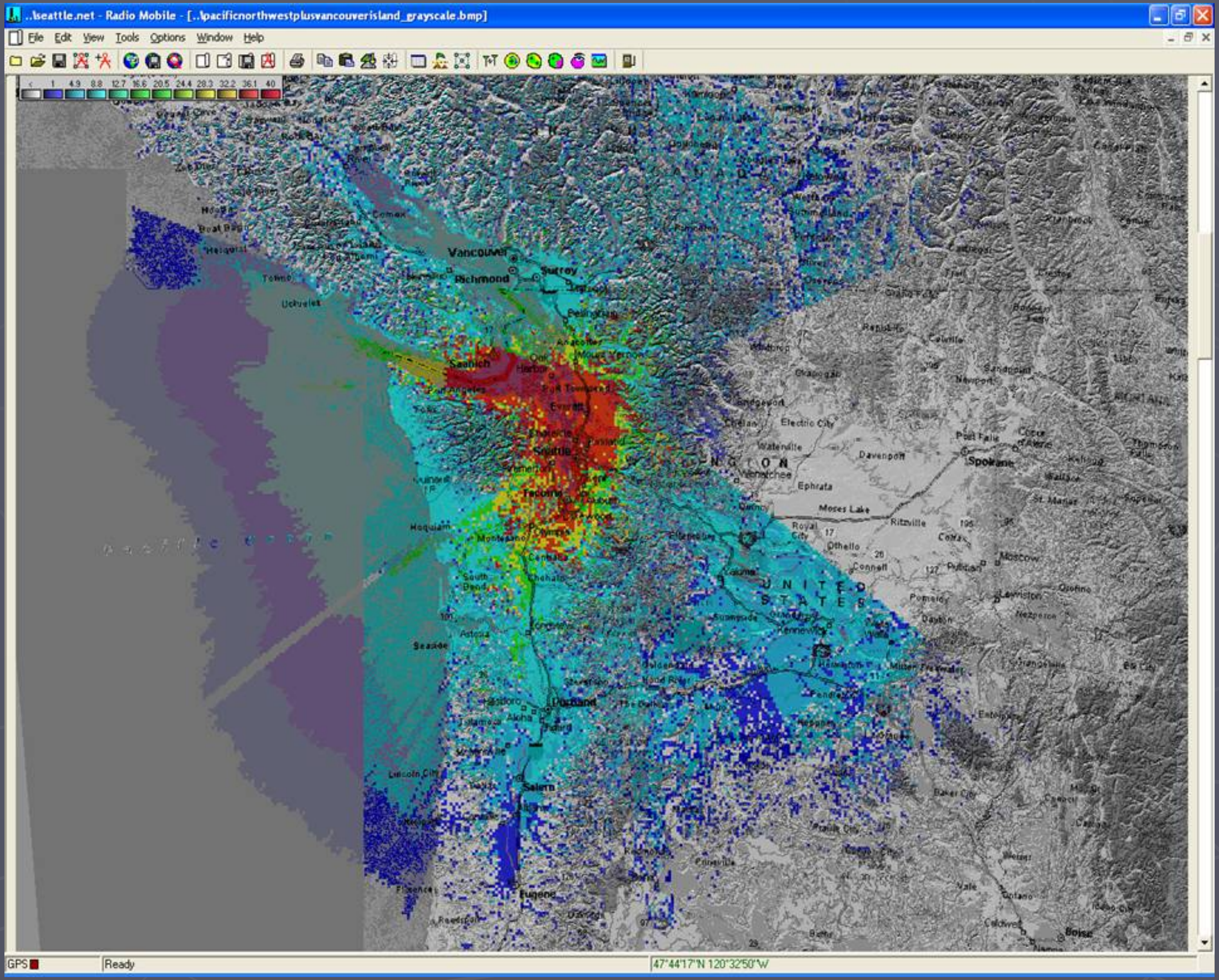
To (<): 40

Draw size (pixels): 3

☑ Rainbow

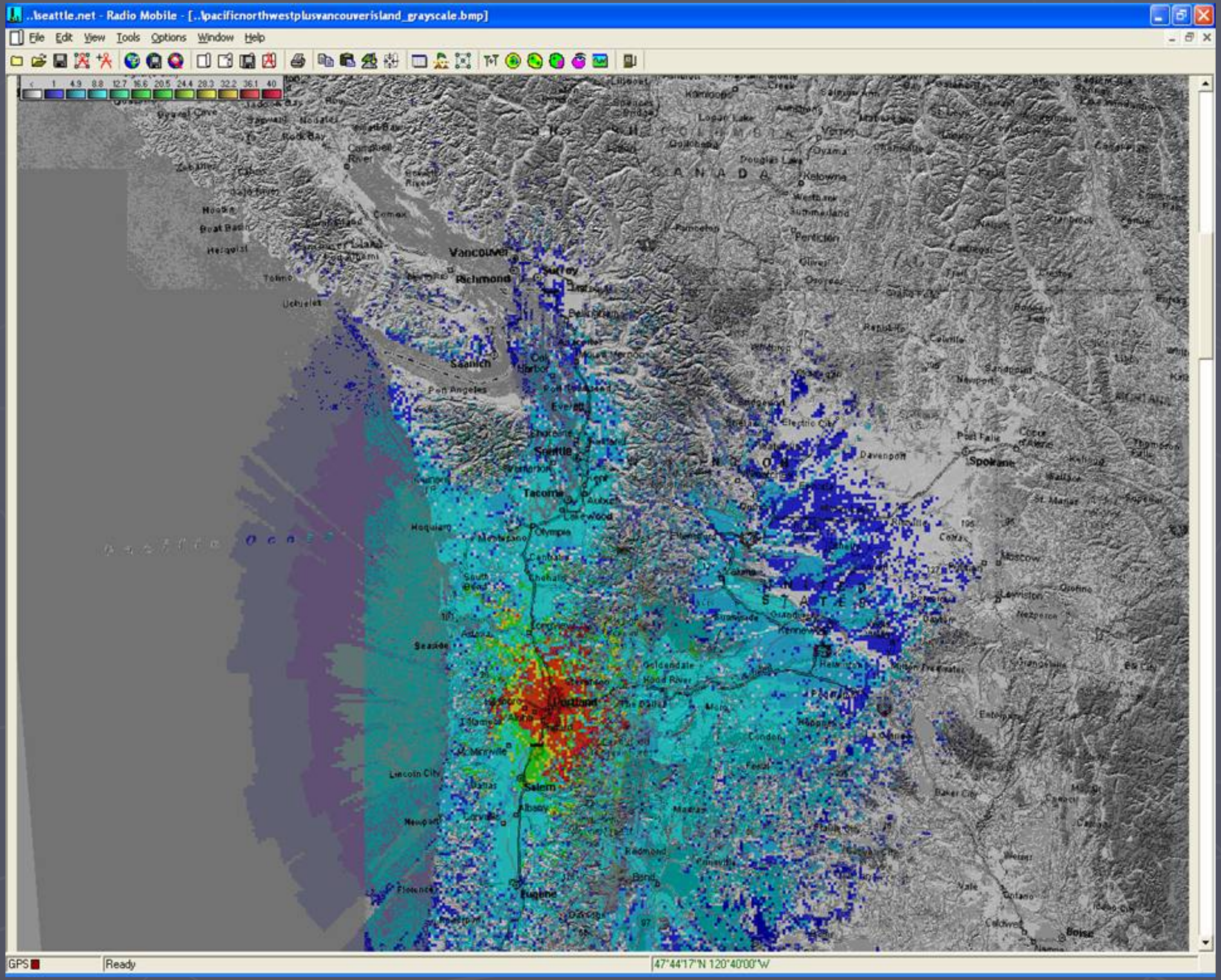
Tools: Radio Coverage Combined Cartesian

- Mobile TX (Could be a Repeater) Coverage from Green Mtn.
- Note intensity coloring
- Portland is in fringe coverage area



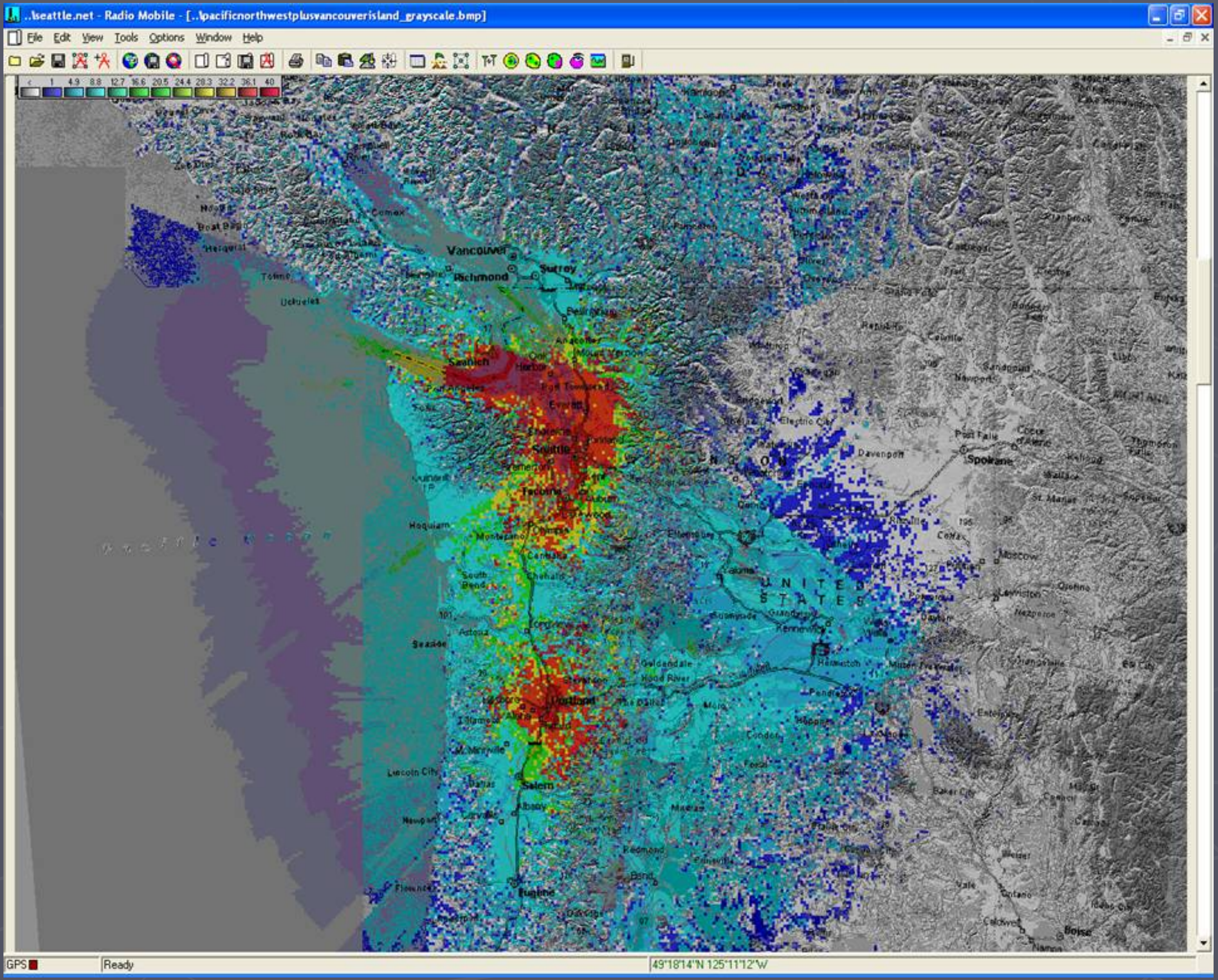
Tools: Radio Coverage Combined Cartesian

- Mobile TX (Could be a Repeater) Coverage from Portland.
- Note intensity coloring
  - Station is not located on a mountain top
- Seattle is in fringe coverage area



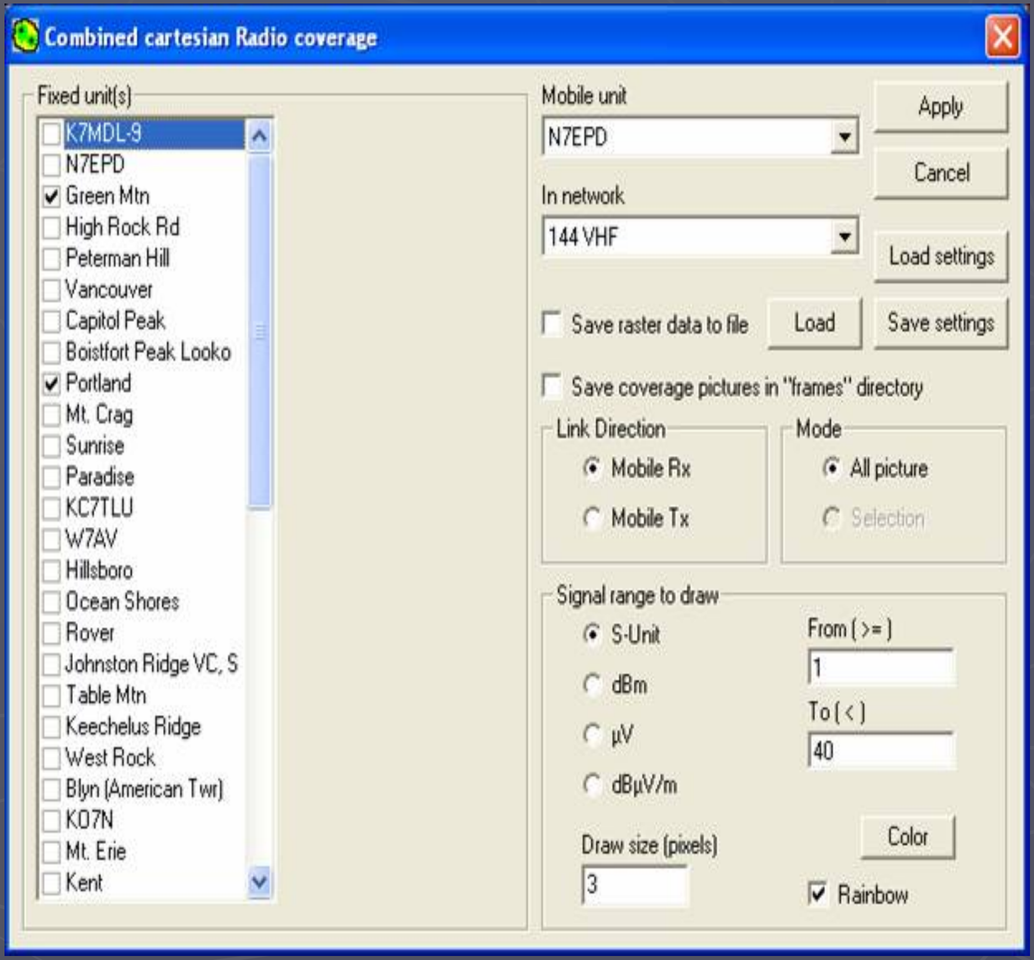
Tools: Radio Coverage Combined Cartesian

- Added 3rd station in Tacoma.
- Note intensity coloring – Station is not located on a mountain top
- Seattle is in fringe coverage area
- Small low signal gap from Chehalis to Longview



Tools: Radio Coverage Combined Cartesian

- Add N7EPD in Tacoma
  - Make Mobile Unit
  - Make Mobile RX
- Add Green Mtn. and Portland as Fixed Units
- Check Rainbow
- Program merges the 2 non-mobile units coverage areas



Combined cartesian Radio coverage

Fixed unit(s)

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☐ Johnston Ridge VC, S
☐ Table Mtn
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☐ West Rock
☐ Blyn (American Twr)
☐ KO7N
☐ Mt. Erie
☐ Kent

Mobile unit: N7EPD

In network: 144 VHF

☐ Save raster data to file

☐ Save coverage pictures in "frames" directory

Link Direction: ● Mobile Rx ○ Mobile Tx

Mode: ● All picture ○ Selection

Signal range to draw: ● S-Unit ○ dBm ○ µV ○ dBµV/m

From (>=): 1

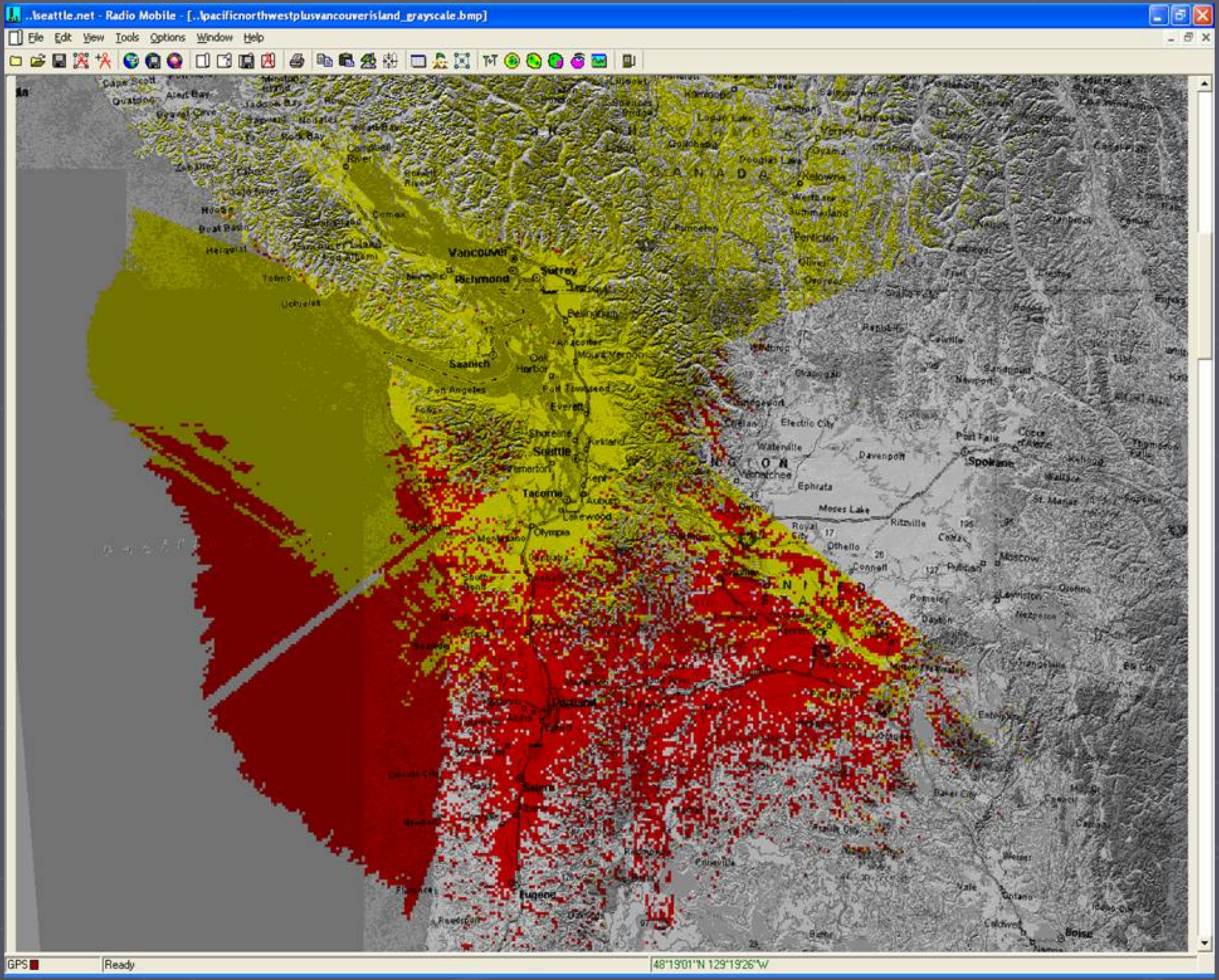
To (<): 40

Draw size (pixels): 3

☑ Rainbow

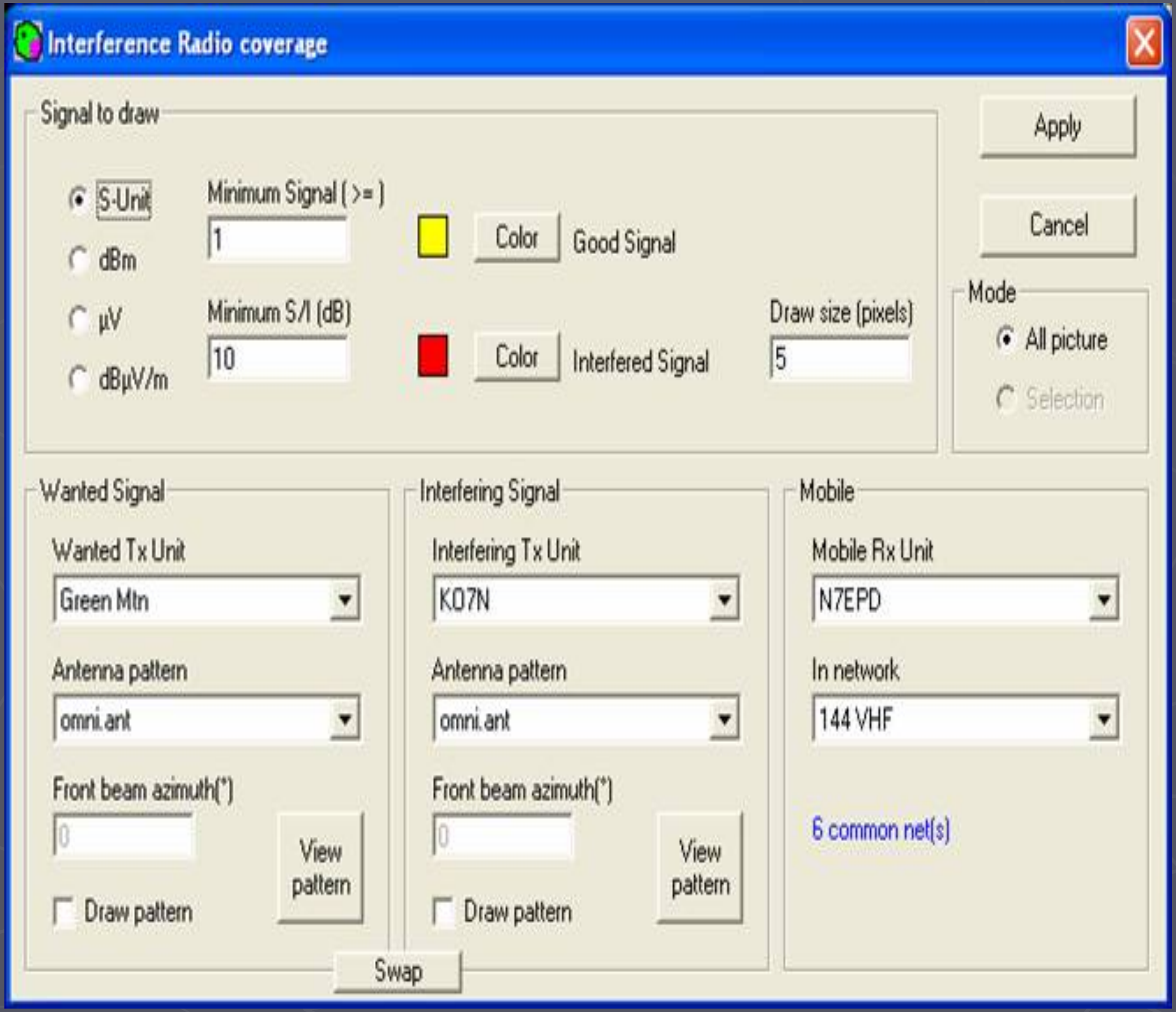
Tools: Radio Coverage Interference

- Repeater is on Green Mtn.
- Rx mobile station is in Tacoma trying to hear repeater Green Mtn.
- Interfering station in Portland, Oregon
- Colors show overall expected RX range of Repeaters
- Red shows where Oregon station will be heard over the Repeater



Tools: Radio Coverage Interference

- Useful for repeater coverage planning when occupying same frequency
- Identify Overlap in coverage
- Select antenna pattern
- Which station should be strongest reception in a given area



Interference Radio coverage

Signal to draw

● S-Unit
○ dBm
○ µV
○ dBµV/m

Minimum Signal (>=) 1

🟨 Good Signal

Minimum S/I (dB) 10

🟥 Interfered Signal

Draw size (pixels) 5

Mode
● All picture
○ Selection

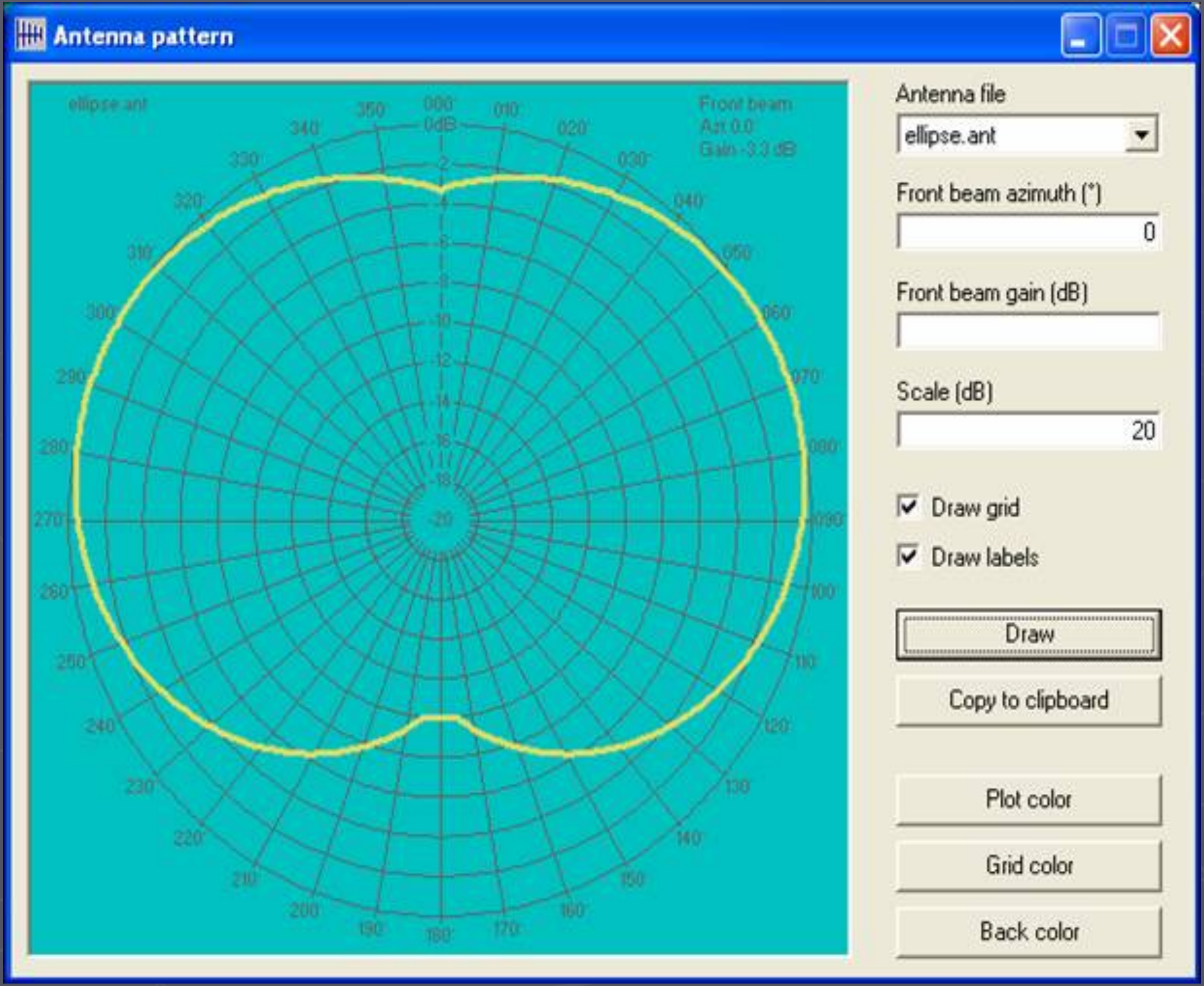
Wanted Signal
Wanted Tx Unit: Green Mtn
Antenna pattern: omni.ant
Front beam azimuth(°): 0
☐ Draw pattern

Interfering Signal
Interfering Tx Unit: K07N
Antenna pattern: omni.ant
Front beam azimuth(°): 0
☐ Draw pattern

Mobile
Mobile Rx Unit: N7EPD
In network: 144 VHF
6 common net(s)

☺ Tip: Antenna Patterns

- Most examples here are using omni antenna patterns
- Can use yagi or other patterns



Antenna file: ellipse.ant

Front beam azimuth (°): 0

Front beam gain (dB):

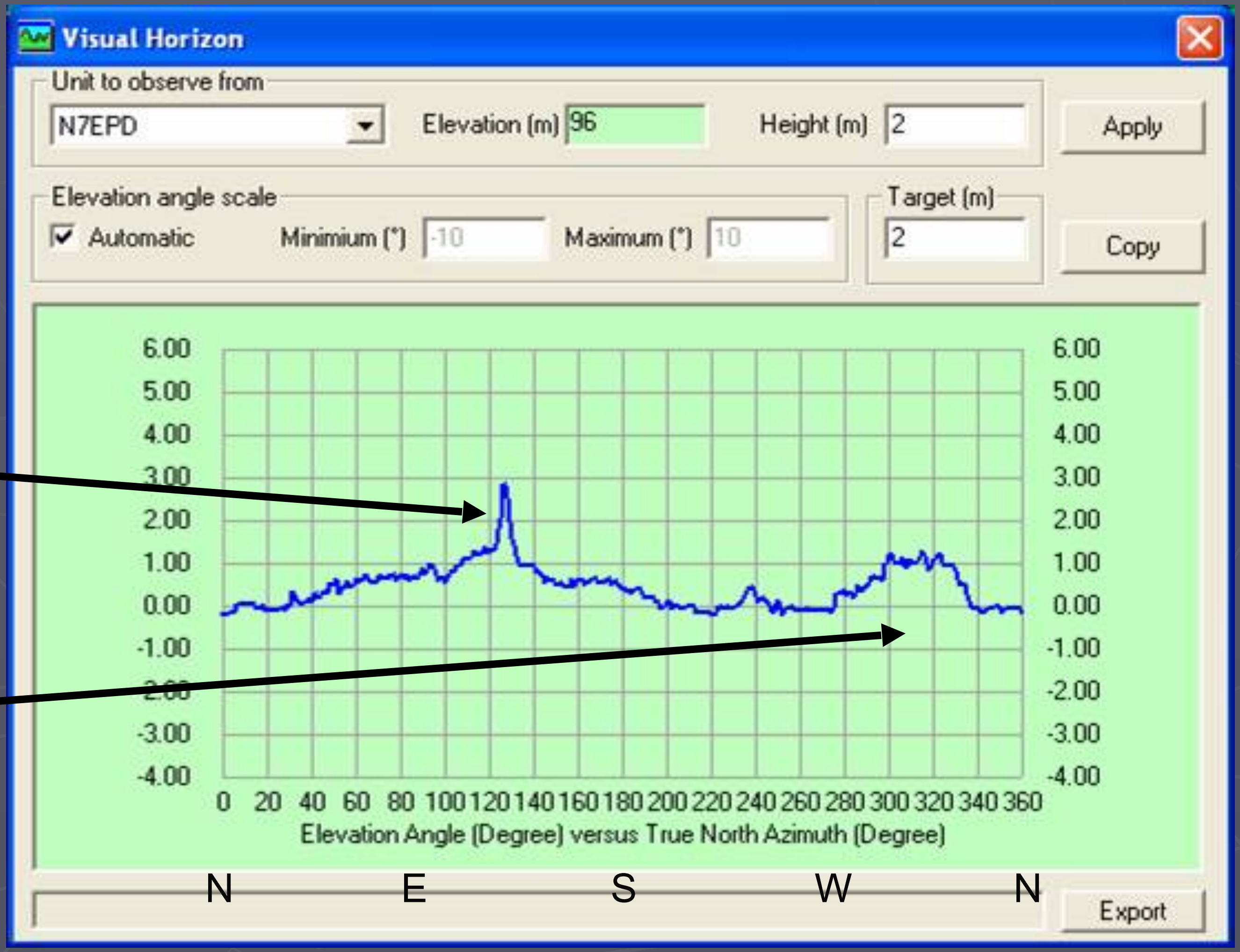
Scale (dB): 20

☑ Draw grid

☑ Draw labels

Tools: Visual Horizon

- 360 degree view from operator position in Tacoma
- Mt. Rainier at 125 degrees
- Olympic Mtns. at 310 degrees



Visual Horizon

Unit to observe from

N7EPD

Elevation (m) 96

Height (m) 2

Elevation angle scale

☑ Automatic

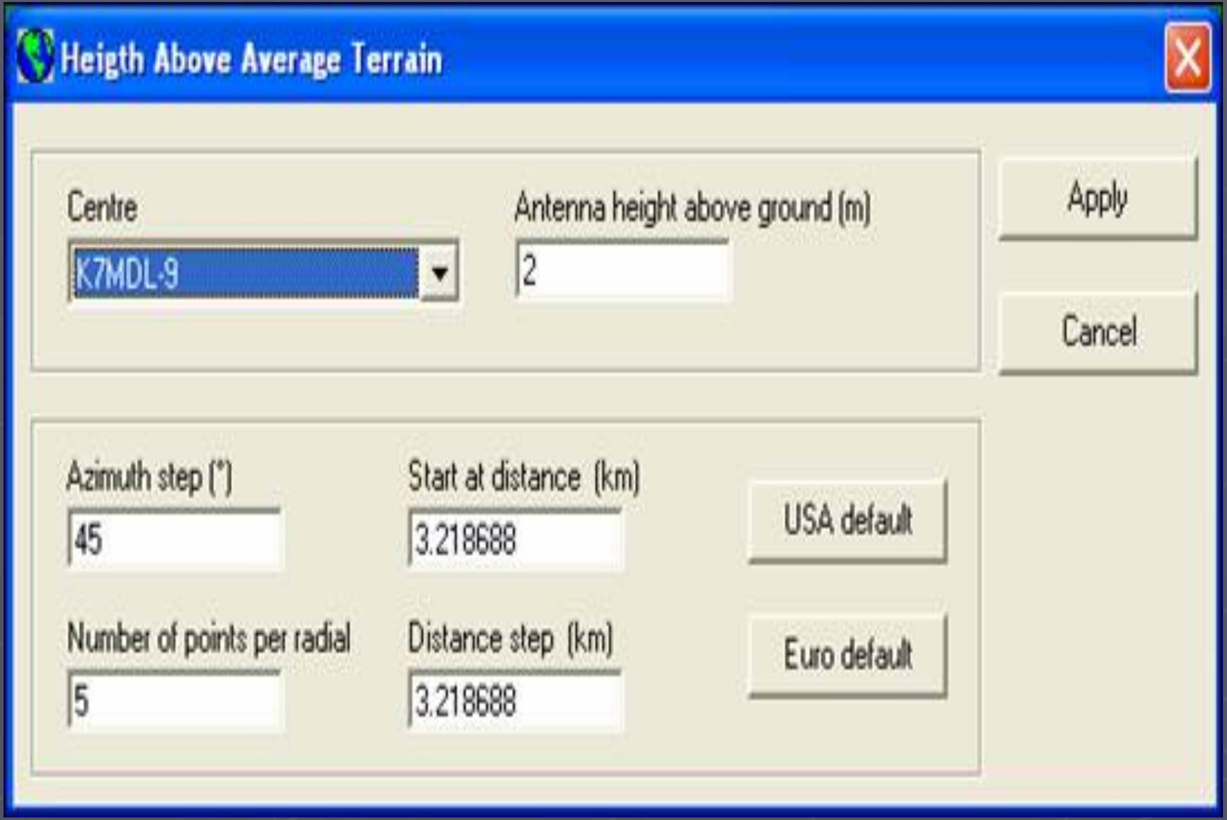
Minimum (°) -10

Maximum (°) 10

Target (m) 2

Tools: HAAT

- Height Above Average Terrain
- 5 circles every 2 miles from antenna
- Elevation recorded at every 45 degree intersection with circles



Heigth Above Average Terrain

Centre: K7MDL-9

Antenna height above ground (m): 2

Azimuth step (°): 45

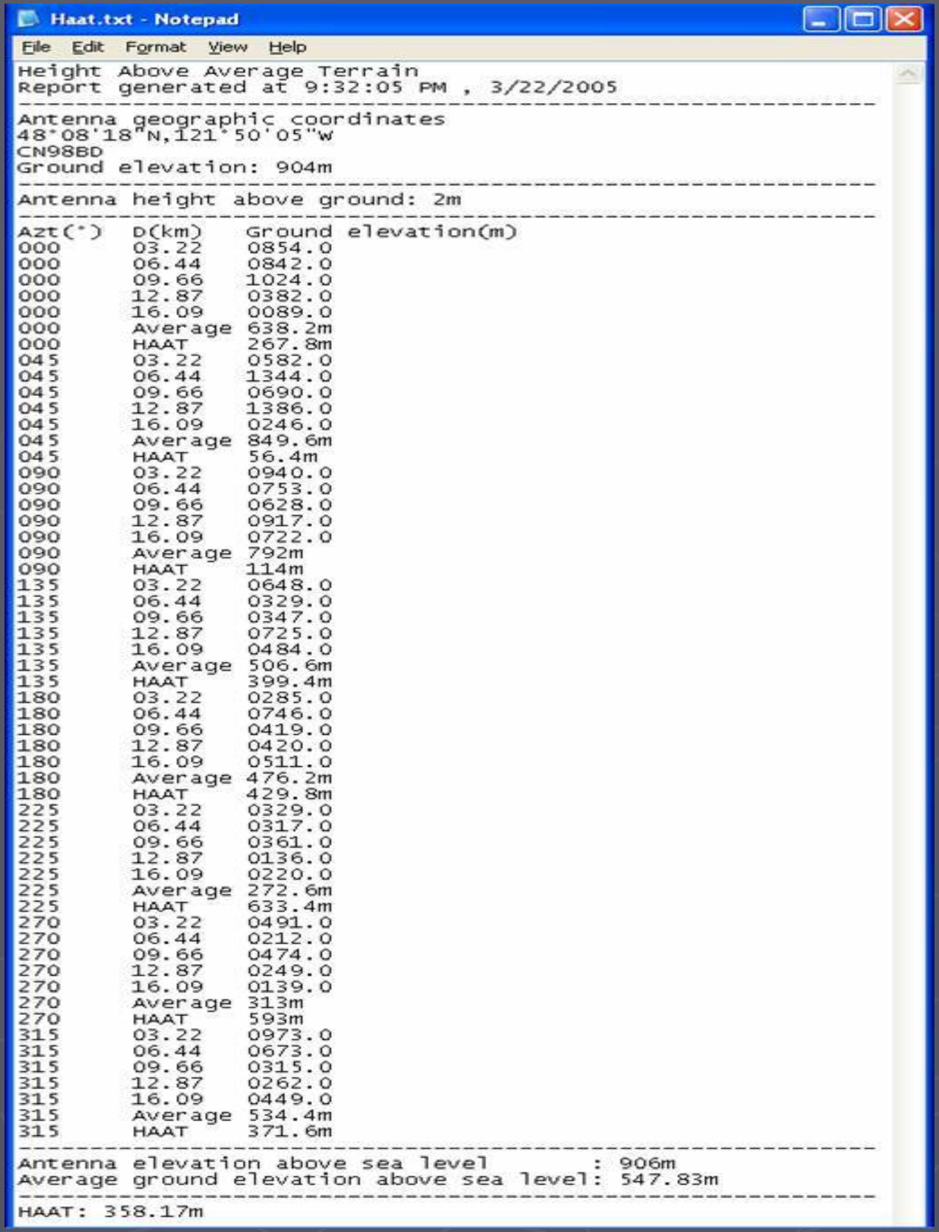
Start at distance (km): 3.218688

Number of points per radial: 5

Distance step (km): 3.218688

HAAT

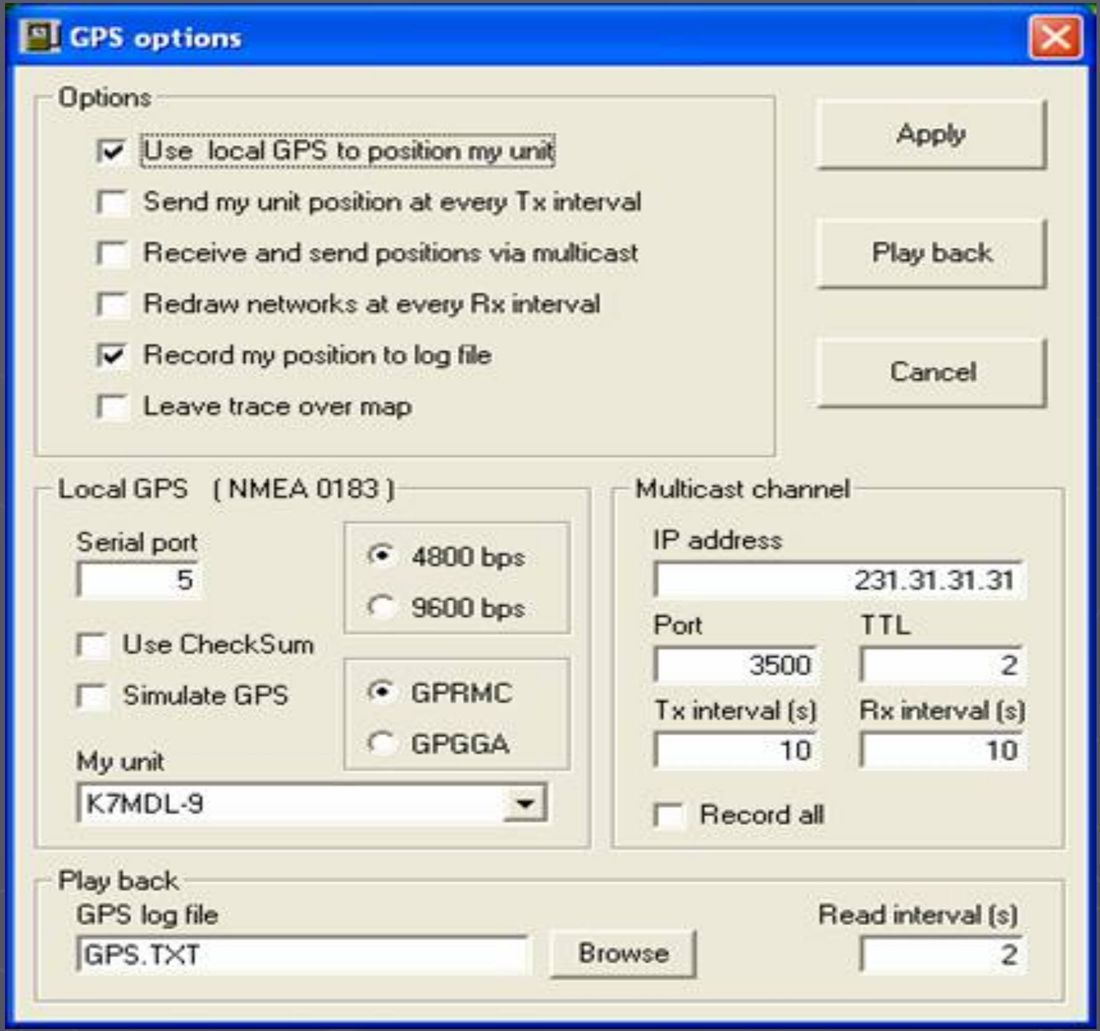
- Green Mtn. used as example
- 358.17m height above average terrain
- Useful for repeater coordination forms
- Every Commercial Radio/TV station files with FCC and records HAAT value



```
Height Above Average Terrain
Report generated at 9:32:05 PM , 3/22/2005
------------------------------------------------------------
Antenna geographic coordinates
48°08'18"N,121°50'05"w
CN98BD
Ground elevation: 904m
------------------------------------------------------------
Antenna height above ground: 2m
------------------------------------------------------------
Azt(°)   D(km)    Ground elevation(m)
000      03.22    0854.0
000      06.44    0842.0
000      09.66    1024.0
000      12.87    0382.0
000      16.09    0089.0
000      Average  638.2m
000      HAAT     267.8m
045      03.22    0582.0
045      06.44    1344.0
045      09.66    0690.0
045      12.87    1386.0
045      16.09    0246.0
045      Average  849.6m
045      HAAT     56.4m
090      03.22    0940.0
090      06.44    0753.0
090      09.66    0628.0
090      12.87    0917.0
090      16.09    0722.0
090      Average  792m
090      HAAT     114m
135      03.22    0648.0
135      06.44    0329.0
135      09.66    0347.0
135      12.87    0725.0
135      16.09    0484.0
135      Average  506.6m
135      HAAT     399.4m
180      03.22    0285.0
180      06.44    0746.0
180      09.66    0419.0
180      12.87    0420.0
180      16.09    0511.0
180      Average  476.2m
180      HAAT     429.8m
225      03.22    0329.0
225      06.44    0317.0
225      09.66    0361.0
225      12.87    0136.0
225      16.09    0220.0
225      Average  272.6m
225      HAAT     633.4m
270      03.22    0491.0
270      06.44    0212.0
270      09.66    0474.0
270      12.87    0249.0
270      16.09    0139.0
270      Average  313m
270      HAAT     593m
315      03.22    0973.0
315      06.44    0673.0
315      09.66    0315.0
315      12.87    0262.0
315      16.09    0449.0
315      Average  534.4m
315      HAAT     371.6m
------------------------------------------------------------
Antenna elevation above sea level       : 906m
Average ground elevation above sea level: 547.83m
------------------------------------------------------------
HAAT: 358.17m
```

Options: GPS

- Driving surveys
  - Verify actual received strength compared to prediction
- Provides location to APRS feature
- Translate into 6 digit Maidenhead grid with Elevation Grid table
- I use an inexpensive USB GPS module on Laptop



Options

☑ Use local GPS to position my unit
☐ Send my unit position at every Tx interval
☐ Receive and send positions via multicast
☐ Redraw networks at every Rx interval
☑ Record my position to log file
☐ Leave trace over map

Local GPS (NMEA 0183)

Serial port: 5
● 4800 bps
○ 9600 bps
☐ Use CheckSum
☐ Simulate GPS
● GPRMC
○ GPGGA
My unit: K7MDL-9

Multicast channel

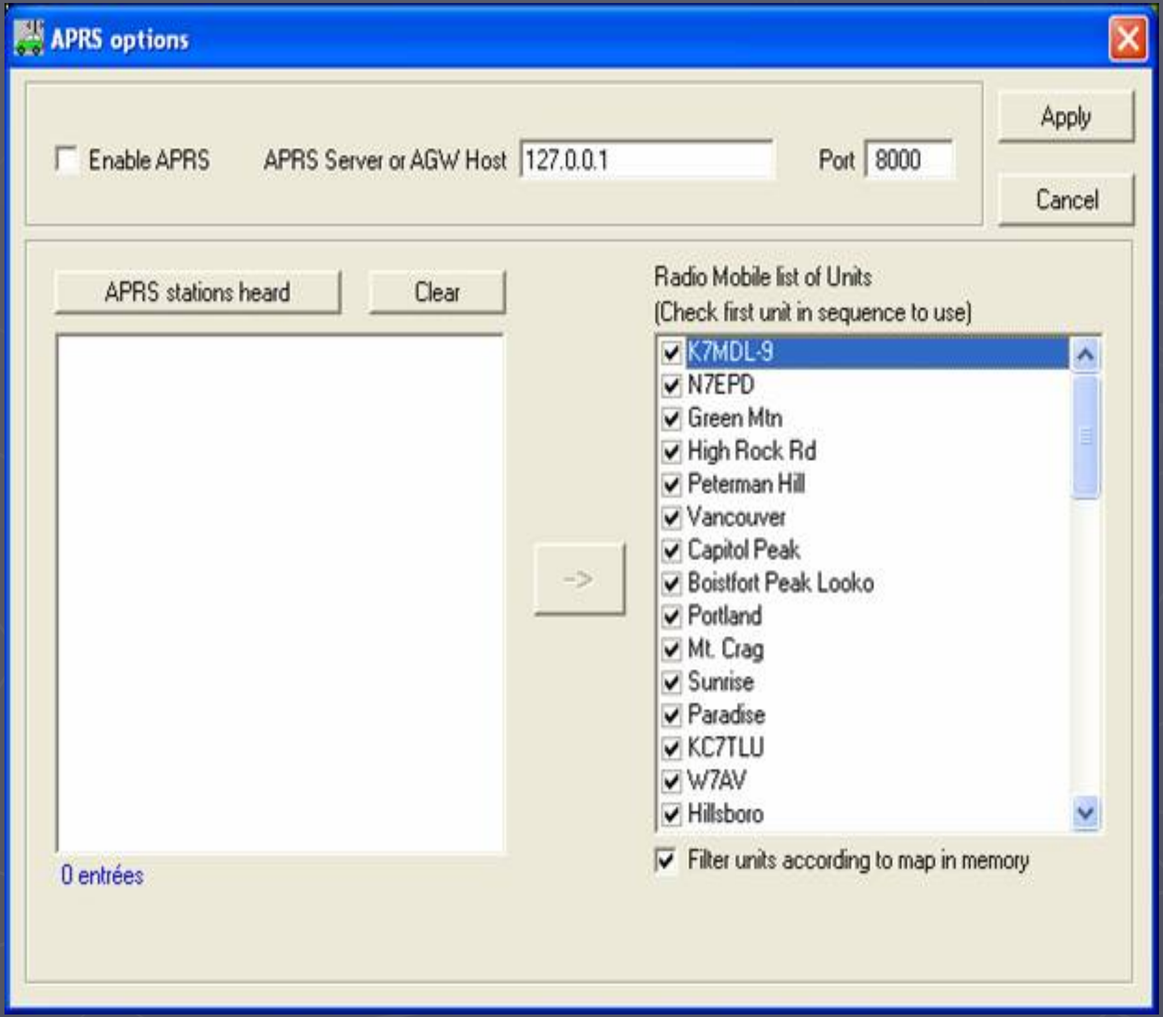
IP address: 231.31.31.31
Port: 3500
TTL: 2
Tx interval (s): 10
Rx interval (s): 10
☐ Record all

Play back

GPS log file: GPS.TXT
Read interval (s): 2

Options: APRS

- As a fixed station tool, can plot positions of selected mobile units
- Provides free detailed mapping with customizable topographic features



☐ Enable APRS

APRS Server or AGW Host 127.0.0.1

Port 8000

Radio Mobile list of Units
(Check first unit in sequence to use)

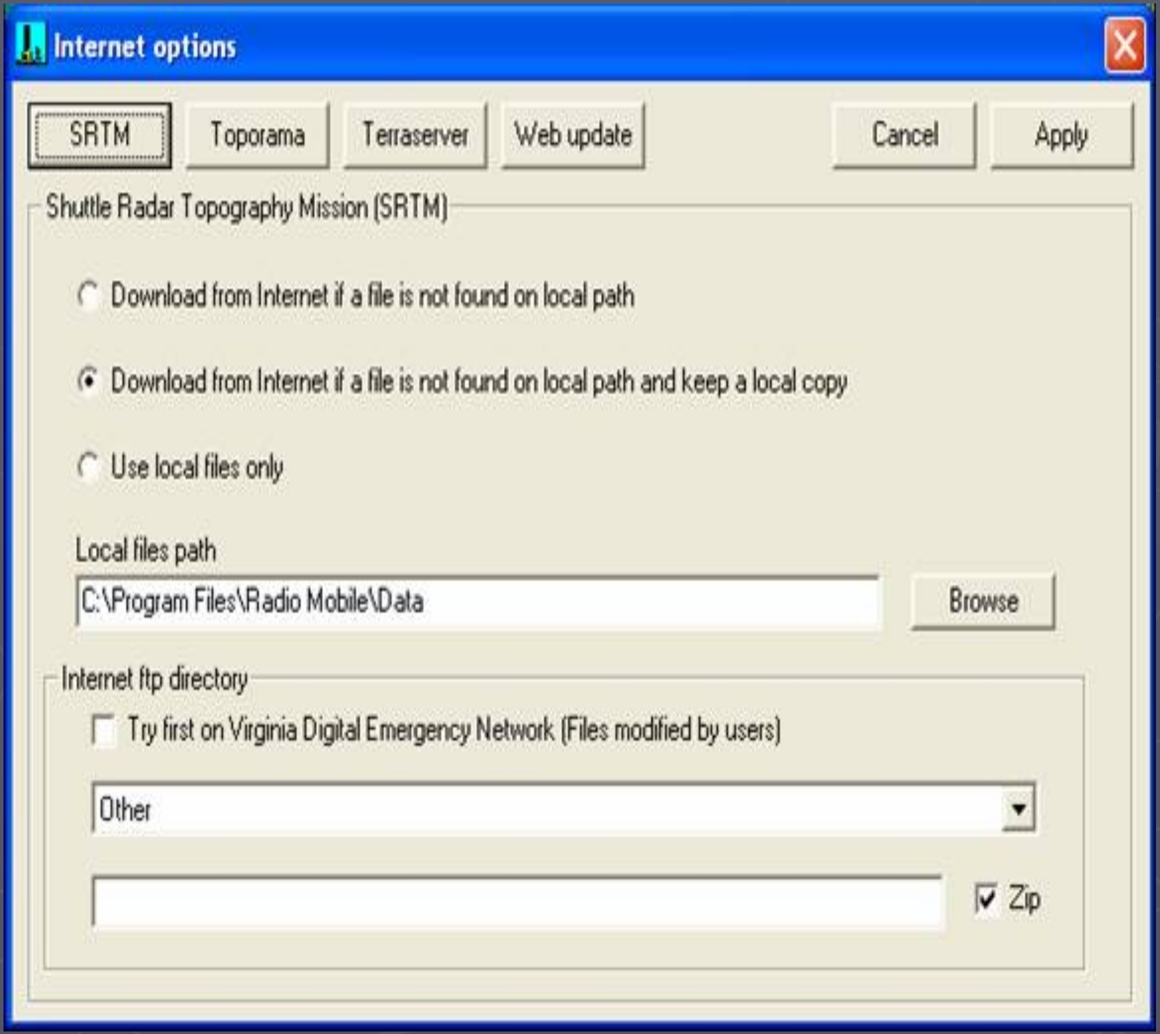
- ☑ K7MDL-9
- ☑ N7EPD
- ☑ Green Mtn
- ☑ High Rock Rd
- ☑ Peterman Hill
- ☑ Vancouver
- ☑ Capitol Peak
- ☑ Boistfort Peak Looko
- ☑ Portland
- ☑ Mt. Crag
- ☑ Sunrise
- ☑ Paradise
- ☑ KC7TLU
- ☑ W7AV
- ☑ Hillsboro

☑ Filter units according to map in memory

0 entrées

Options: Internet Data Sources

- Key feature automates the data file download for SRTM and other data
- Automatically checks for program updates (frequent updates are made)



Shuttle Radar Topography Mission (SRTM)

○ Download from Internet if a file is not found on local path

● Download from Internet if a file is not found on local path and keep a local copy

○ Use local files only

Local files path

C:\Program Files\Radio Mobile\Data

Internet ftp directory

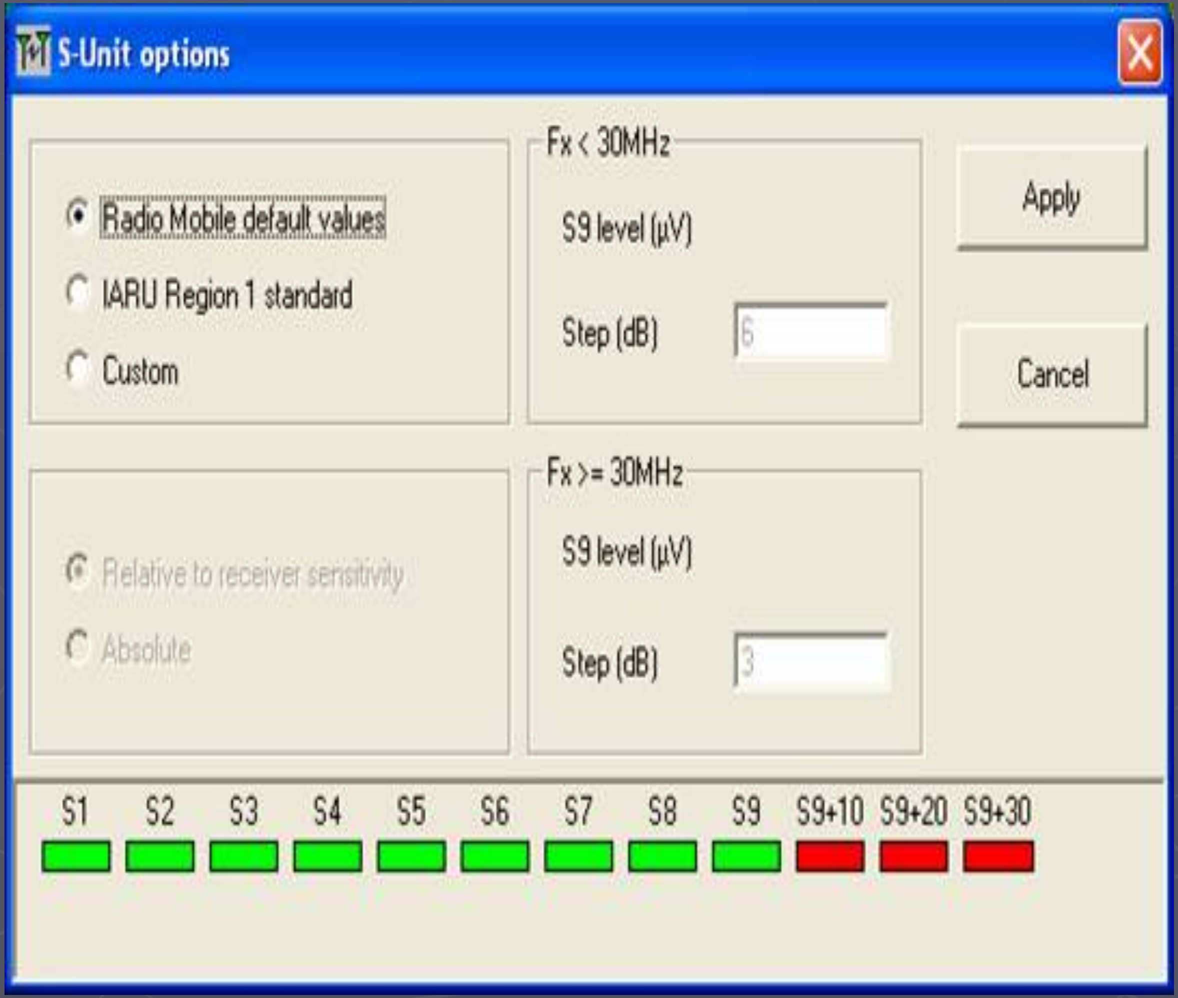
☐ Try first on Virginia Digital Emergency Network (Files modified by users)

Other

☑ Zip

Options: S-Units

- Select definition of an S-Unit
- Notice HF and VHF defaults are different
- Can set by microvolt level if desired with Custom
- Elecraft XG-1 gives -73dBm (50uV) for S9 @ 7.040MHz



S-Unit options

● Radio Mobile default values
○ IARU Region 1 standard
○ Custom

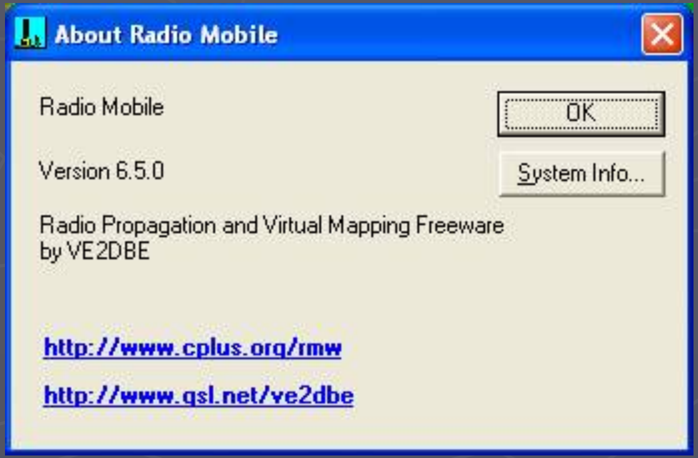
Fx < 30MHz
S9 level (µV)
Step (dB) 6

Fx >= 30MHz
S9 level (µV)
Step (dB) 3

● Relative to receiver sensitivity
○ Absolute

Where to find the Software

- http://www.cplus.org/rmw
- http://www.qsl.net/ve2dbe
- Web site provides links to data sources, map sources, city database, more



About Radio Mobile

Radio Mobile

Version 6.5.0

Radio Propagation and Virtual Mapping Freeware
by VE2DBE

http://www.cplus.org/rmw

http://www.qsl.net/ve2dbe